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Technical Report 4

REPORT ON DATA RETRIEVAL AND ANALYSIS OF USAF SONIC BOOM CLAIMS FILES

Prepared for:

NATIONAL SONIC BOOM EVALUATION OFFICE
1400 WILSON BOULEVARD
ARLINGTON, VIRGINIA

CONTRACT AF49(638)-1696

STANFORD RESEARCH INSTITUTE

MENLO PARK, CALIFORNIA

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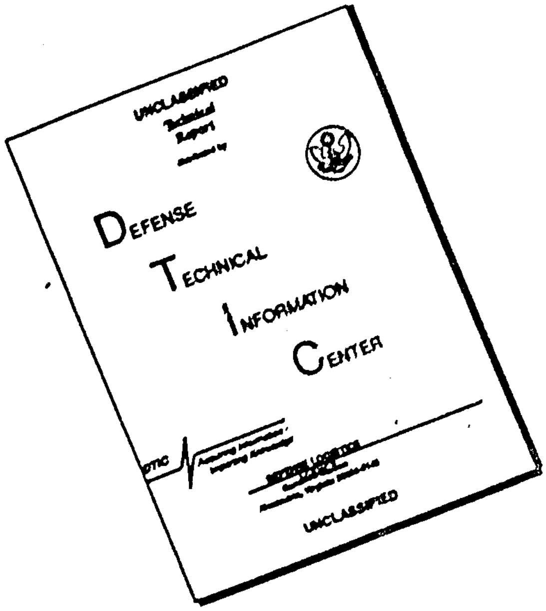

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SRI Project No. ETU-5897

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I INTRODUCTION

I INTRODUCTION

This report covers the retrieval, analyses, and presentation of data from Air Force sonic boom damage files. These files were the only known available source of claims information on alleged sonic boom damage to structures. This source of data consists of the actual Air Force claims files. It is probable that the decisions to pay or not pay specific claims represent many varied standards of probability and of necessity, largely subjective judgments of claims personnel with varying degrees of training and experience. In the absence of a standard for validation of the input data no hard conclusions may be drawn as to the degree of confidence which can be placed in the inferences drawn from the data analyses in this report.

Stanford Research Institute began developing a comprehensive data retrieval and reporting system early in 1966, after a preliminary review of filed sonic boom damage claims and discussions with Air Force personnel at both Headquarters and Air Materiel Area Levels. The system developed supplements the data output format used by the Air Force in its Claims Data Management System. Although different in purpose, both systems can be correlated, because claim file numbers are common. The sonic boom claims data bank, located at the Institute's Menlo Park office, is the repository for all the information retrieved to date. The data are in the form of key punch cards and magnetic tape, either of which can be used with electronic sorters or computers.

Where the interim report presented paid claims data for the overflight programs at Oklahoma City, Chicago, Pittsburgh, and Milwaukee, this report includes data on (1) paid and unpaid claims from the 1965 St. Louis overflight program, (2) unpaid claims in the Pittsburgh and Milwaukee boom areas and a portion of the Oklahoma City boom area, (3) all sonic boom claims received by the Air Force during FY66, and (4) appealed claims from all these areas. Information from files resulting from the June 1966 sonic boom program at Edwards Air Force Base is also included, insofar as comparisons could be made.

An additional purpose of this study was to investigate the usefulness of all or portions of the retrieved data in predicting the damage claims that might be due to future sonic boom test programs and eventually to the commercial overland use of the SST in the nation's air transport system.

The study was not intended to determine the validity of the damage cases considered by judging particular damage from sonic booms. The claims in the data bank have already been judged by the Air Force--6 percent were paid in Oklahoma City, and up to 47 percent were paid in the B-58 cities.

Further, claims-to-payment ratios as such may not be appropriate measures of validity in any event; the relationship of absolute damage to an absolute data base (existing population and structure profile, urban-rural densities, and particular claimant characteristics) may be more appropriate. Current work on the relevance of various parameters may shed light on this matter.

Table 1 gives general complaint and claims information reported in Air Force records and reflects the additional source data used for this report. It also updates similar data presented previously.

Figure 1 illustrates the theoretical flow of data from origination to its segregation into isolated data bank elements. As noted, the material here is not addressed to (1) the physical characteristics of sonic boom phenomena, which are covered in other Institute reports by the definition study team, or to (2) "complaints," whether for damage or other reasons. (There is no compilation of such data in the records of the Air Force.)

Although the method used in providing information storage in the data bank is essentially the same as described in the interim report as appended here, some refinements and additions have been made. Appendix A indicates the new designators and descriptors and a revised claims record form. The additions were instigated primarily to accommodate FY66 data and the various payment situations arising from appealed claims and for more complete descriptions of alleged structural and other miscellaneous type damage.

Table 1

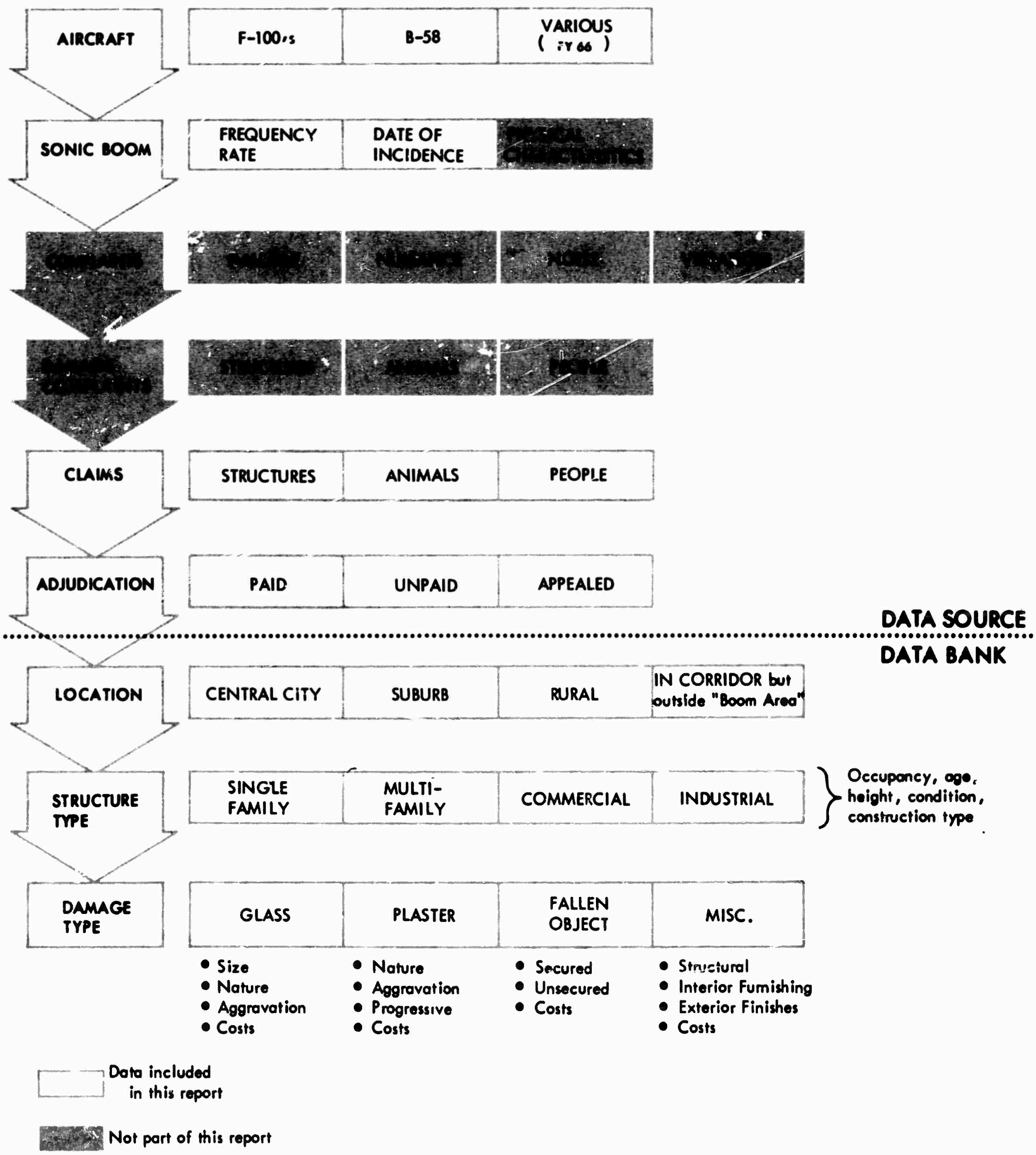
GENERAL CLAIMS INFORMATION
(Revised)

Boom Area	Total Booms	Boom Date (incl.)	Aircraft Type	Damage Complaints Received*	Damage Claims		Claims Adjudicated*	Claims Paid†	
					Received*	% of Complaints		Paid*	% of Adjudicated
Oklahoma City	1,253	Feb.- July 1964	F-101(562) F-104(669) F-106(10) B-58(12)	9,708	4,901	50	4,901	289	6
Chicago	49	Jan.- March 1965	B-58	7,128	3,156	44	3,116	1,464	47
Pittsburgh	50	April- June 1965	B-58	1,848	1,102	60	1,088	503	46
Milwaukee	61	July- Sept. 1965	B-58	953	639	67	621	259	42
St. Louis	22	July- Sept. 1965	B-58	1,390	491	35	476	215	45
FY66	--	Jan.'65 June'66	‡	--	--	--	1,409§	721§	51

* Through October 1966, Special Claims Offices: Final Report.
† Does not include paid appeals.
‡ 25% Sample -- 72% F-100, F-4, F-5; 12% SR-71, YF-12; 11% B-58; 4% B-70; 1% T-38.
§ From the data bank.

Figure 1

DATA FLOW DIAGRAM



II SUMMARY

II SUMMARY

Generally, about three-fourths of all alleged claims for damage involved single family structures. Commercial structures accounted for one-sixth of the claims with multifamily structures, automobiles, m scellaneous structures, and people and animals constituting less than 10 percent. The structures were 84 percent owner occupied, 90 percent in fair-to-sound condition, 90 percent of one and two stories, and about 50 percent built after World War II. Glass, plaster, and "other" types of damage were almost equally claimed in single family residences; however, glass was by far the predominant type in commercial structures--76 percent. The average paid claim alleged damage of $93, though payment averaged $72.

Of all claims, the proportions of single family paid and denied claims were about the same. On the other hand, claims for commercial and multifamily structures were more likely to be paid--two to three times more likely for commercial establishments and 25 to 50 percent more likely for multifamily structures. Although there was generally little difference between paid and denied claims in regard to type of occupancy, age, condition, or geographic distribution of damaged structures, there were considerable differences in the distribution of damage types between paid and denied claims. By and large, the percentage of glass damage paid was three times greater than that denied, whereas the percent of miscellaneous damage denied was five times greater than that paid. Plaster-type damage and fallen objects varied widely; however, considering each of the areas separately, comparisons favored denial for plaster and payment for fallen objects.

At least 50 percent of the paid claims--as much as 92 percent in Oklahoma City--originated from within the corporate limits of the target city; possible-to-probable damage also occurred in suburban fringes and satellite cities and in semirural areas. In all cases, at least 92 percent of this paid damage occurred within a 20 mile corridor along the flight track.

Damage involving single family structures constituted 68 percent of the paid claims (8 percent were multifamily units and 24 percent commercial). When claims are compared with the existing data base of all living and commercial units, commercial establishments are found affected three to four times as severaly as single family structures, whereas multifamily units show only about 30 percent of the effect on single family units.

Eighty percent of the structures involved in the paid claims were owner occupied. Of the single family structures damaged, 90 percent were owner occupied, compared with 75 percent in the data base of existing structures, as determined from the U.S. Census. Owners claimed sonic boom damage at a rate about three times greater than lessees.

Age of structures, based on pre- and post-World War II construction periods, was not a significant factor in Oklahoma City, Pittsburgh, and Milwaukee; but in Chicago and St. Louis, damage to units built in the last 25 years occurred at a rate about three times greater than units older than 25 years according to comparisons between claims and Census data.

Nearly three-fourths of the paid incidents were for glass damage in Chicago, Pittsburgh, and FY66; Milwaukee and St. Louis had slightly less than 50 percent glass damage, although glass damage was still the greatest damage type; and Oklahoma City was the only area where plaster damage exceeded glass damage. Miscellaneous-type damage (structural damage, damage to fixtures and ceramic tile, injuries to people and animals) constituted only 5 to 9 percent of the paid incidents. Claims for fallen objects were slightly greater, 6 to 13 percent.

In the plaster damage category, 75 percent of the paid claims concerned the aggravation of preweakened or precracked plaster (the triggering effect of sonic boom). Approximately 50 percent of the plaster damage was evidenced in horizontal, vertical, and random cracking extending generally from the edge or center of the plaster member; this is opposed to 25 percent radiating from corners or extending along angle joints or seams and 25 percent of the fallen plaster type.

Glass incidents, which accounted for approximately 60 percent of the damage to single family homes and 90 percent to commercial establishments, exhibited a trend similar to plaster in that there was a predominant amount of horizontal, vertical, or random cracking radiating from the edge or center. Only a small percentage of cracks occurred at the corners, either across the corner or radiating from it. On the average, when glass was broken, two or three panes were damaged simultaneously in one structure.

For buildings one to four stories high, the percentage of first floor damage tended to decrease with building height, but with a corresponding increase in the percent of damage on each higher floor. Although the amount of damage above five stories was too small to be significant, payments were made for damage in 6, 7, 8, 9, 10, 13, 14, 15, 16, 17, 18, and 40 story structures. Other than two occurrences on the sixth floor, two on the 12th, and one on the 39th, almost all damage occurred on the ground floor.

By and large, paid glass damage was the greatest damage in the B-58 cities, and paid plaster damage the greatest in Oklahoma City, where 99 percent of the overflights were by fighters. In FY66, however, a 62 percent sample of paid incidents indicated that fighter aircraft occasioned a slightly greater percentage of glass damage (76 percent) than did B-58 bombers (68 percent).

In the five controlled overflight programs, Chicago and Pittsburgh paid 87 cents on the dollar of estimated repair cost, whereas Milwaukee and St. Louis paid 55 cents. Oklahoma City fell in between with 70 cents, and FY66 was very similar with 72 cents. The weighted average of all paid amounts was $72 per claim in the five cities. On the other hand, FY66 was $103 per paid claim.

Considering all areas, one claim out of ten was appealed. This rate varied from about one appeal for every fourteen claims in the B-58 cities to an average of one out of every six and a half claims in Oklahoma City. Appeals averaged $500, although only $75 per appeal was paid to 3 percent of the appellants.* Total amounts paid under the appeal procedure amounted to less than 1 percent of all payments in the B-58 cities and 6 percent in Oklahoma City. Of the appealed cases, 90 percent involved single family residences and 90 percent were in owner occupied structures. Where cities have been suburban sprawl, there was equal chance of the appellant living in either the central city or a suburb. The highest incidence of appeals involved miscellaneous damages not normally considered susceptible to damage by sonic boom--hot water heaters, bathroom fixtures, concrete foundations, and TV sets.

There were 0.7 cases of personal injury per 1,000 claims in the five boom areas and 3.5 per 1,000 claims on nationwide bases in FY66. Overall, however, only 16 percent were considered valid, less than 0.02 percent of all claims.

The claims incidence for startle to animals is almost double that for people in the boom cities (1.3 per 1,000 claims) and almost four times in FY66 (13 per 1,000). Of these, 36 percent were paid at an average of $500.

A previous study of animal cases in FY62 through FY66 reported 5.5 cases per 1,000 claims. Of the claims, 36 percent were paid at an average of $775.

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* Does not include litigated cases.

III DATA BANK

III DATA BANK

Glossary of Terms

Figure 2 shows abbreviations used for the numerous references made to areas where sonic booms have occurred. The following list of definitions is provided for clarity within the report and as a compendium of the "claims" language used by Special Claims Offices and Air Force staff judge advocates, the Institutes' Sonic Boom Definition Study Group, and certain other researchers. The definitions have been reviewed by the legal director, National Sonic Boom Evaluation Group.

The term "incident" evolved from more than one type of damage often being included in one filed claim. This could cause misleading results in the statistical segregation of the various factors considered; consequently, the term may be unique to this report, the data bank, and future projection formulas.

1. Complaint--oral or written report of any kind of grievance, as for example, damage, noise, vibration, personal or animal injury, nuisance, or mental disturbance.

2. Damage Complaint--oral or written report of alleged physical damage or injury to structures, people, or animals.

3. Valid Damage Complaint*--a damage complaint where investigation (or other evidence) shows one or more incidents of alleged damage were probably due to sonic boom.

4. Claim--formal filing of a damage complaint on Standard Form 95 or Air Force Form 1205. After adjudication, the claim may be paid, paid in part, denied, reconsidered, appealed, litigated, or a combination of these.

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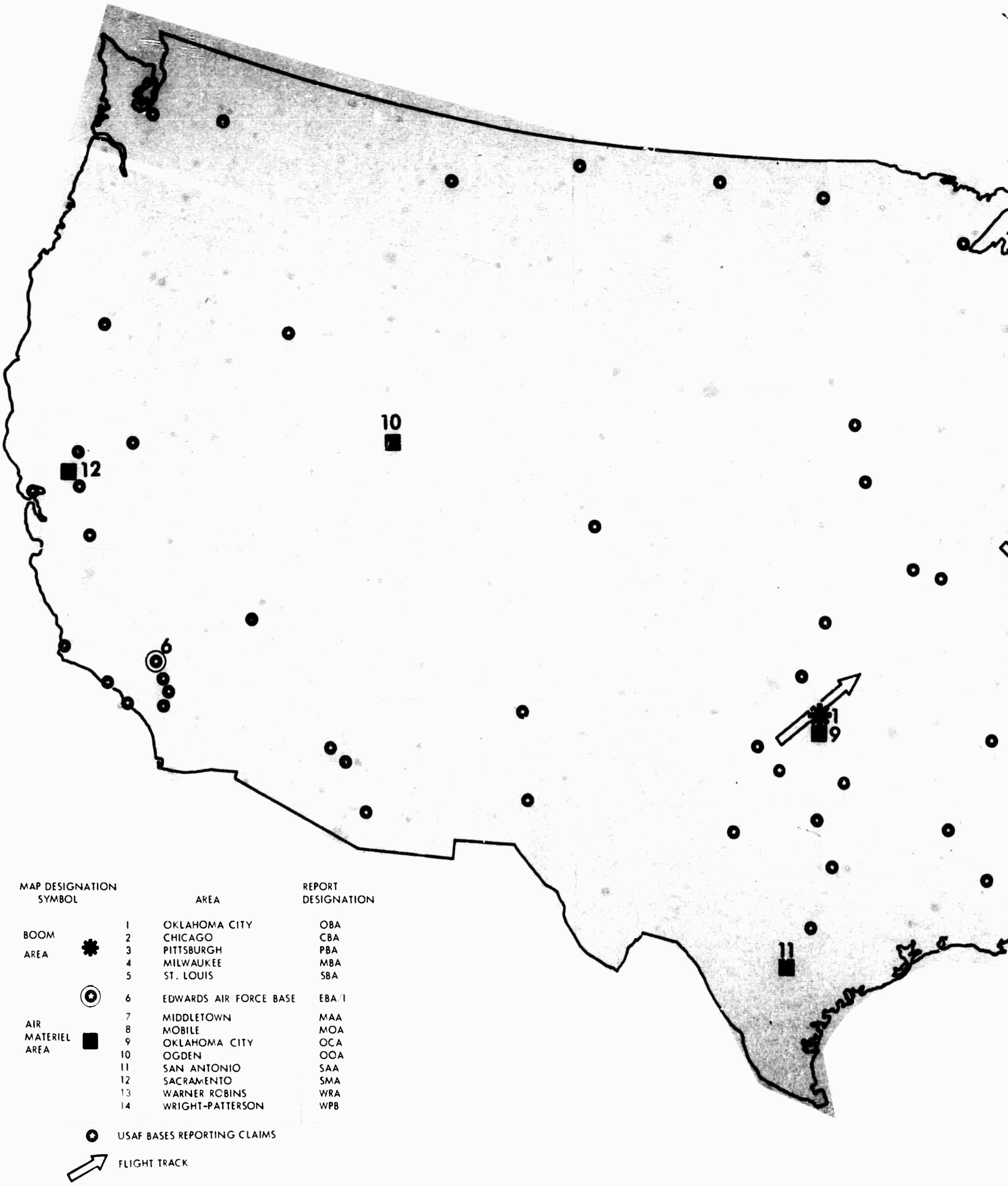
* This classification would be generally used where, for research purposes, a determination of sonic boom causation is necessary prior to formal adjudication.

Figure 2
LOCATION MAP



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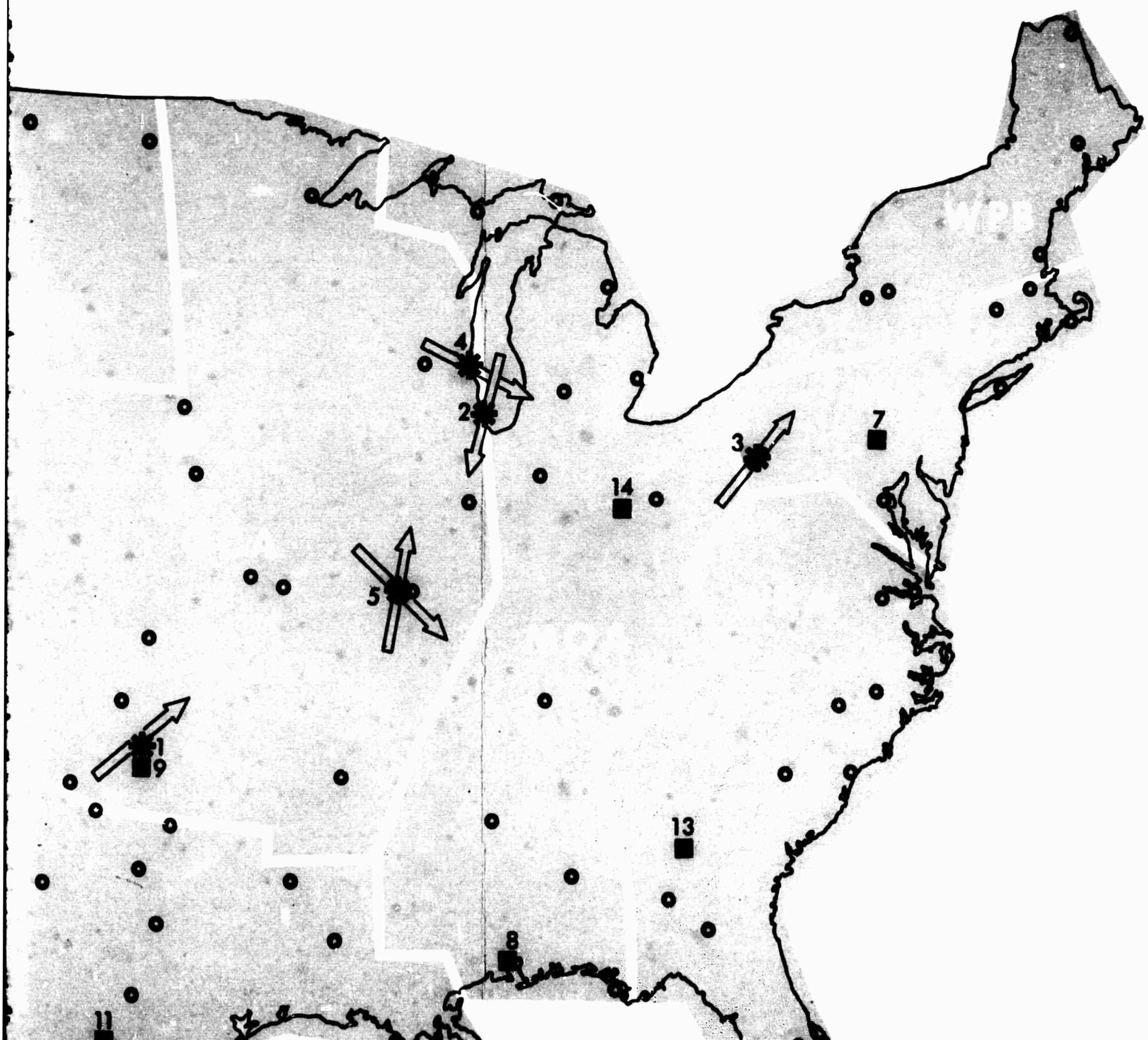

B

5. Damage Incident*--describes only one class of damage to a structure--such as broken glass, plaster, fallen object, or miscellaneous. It may be valid or invalid, paid or denied, and accordingly should always be explicitly qualified.

7. Reconsideration--re-evaluation of a claim by the claims authority that originally acted on the claim. If additional evidence warrants reversal, final disposition of claim is made; otherwise, appeal procedure is followed.

8. Appeal--re-evaluation by Headquarters, U.S. Air Force, of a claim previously finalized.

9. Glass Incident--includes permanently mounted glass, such as panes, panels, windows, doors, and mirrors, damaged in place. It does not include glass that was broken by falling or being hit by a falling object.

10. Plaster Incident--includes damage to plaster walls, ceilings, and panels of lath and plaster "wet" wall or plasterboard "dry" wall. It does not include damage to acoustical tile or other fiberboard materials; nor does it include damage to ceramic or other preformed wall finishes.

11. Fallen Object Incident--includes any object or material that is damaged by falling from either an unsecured position (such as bric-a-brac) or secured position (such as a light fixture).

12. Miscellaneous Incident--includes, for example, damage to bathroom and other plumbing fixtures, TV and other electronic components, appliances, light fixtures broken in place, nail popping, exterior finishes, interior finishes (except plaster), and personal and animal injury.

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* All incidents define the primary damage alleged to be directly caused by sonic boom(s); secondary damage as might be caused by reason of the primary damage is not considered. (Example: glass table top broken by falling plaster.)

13. Structural Incident*--includes damage to structural elements, such as beams, columns, foundations, concrete or masonry walls and floors or slabs; and chimneys, silos, and cisterns.

14. Other Incident--used as a collective classification for combining fallen object incidents, miscellaneous incidents, and structural incidents.

15. Controlled--the term controlled when used in conjunction with controlled supersonic overflights, controlled supersonic overflights and controlled overflight program refers to those areas in which there were systematic scheduled flights. These areas were Oklahoma City, Chicago, Pittsburgh, Milwaukee, and St. Louis. The degree of control in Oklahoma City was infinitely greater than it was in the other cities.

Description

Figure 2 shows the five sonic boom areas where programs of controlled overflights were conducted during 1964-65. Also shown is the location of the June 1966 overflights at Edwards AFB. Because of the wide geographic spread of sonic boom claims in FY66, only the Air Force bases reporting claims and the Air Materiel Area bases that forwarded claims files to the data bank are shown. The data bank contains comparative city-by-city claims information for FY66, although the information is not so analyzed in this report--primarily because the data base on the ground could not be isolated under the conditions where the flight track, speed, and elevation of the aircraft that supposedly caused damage were unknown. On the other hand, certain FY66 data were useful in comparing the types and costs of damage and other information on a generally nationwide basis with information on the five particular city areas.

Of the some 11,600 claims from all these areas adjudicated before 31 October 1966, the data bank includes information from 5,572 (see Table 2). Although this indicates a sample of approximately 50 percent, it is more realistic to consider sample representation on an area-by-area basis. Specifically, the data bank contains a 94 percent or more sample of all claims in Pittsburgh, Milwaukee, St. Louis, and FY66; 45 percent of the claims in Chicago (which represents 95 percent of the paid claims); and 13 percent of the Oklahoma City claims. In the case of OBA, 84 percent of the paid claims are included in the sample.

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* For purposes of this report, structural incidents are included in miscellaneous incidents.

Table 2

DATA BANK SUMMARY*

	Total		Paid		Denied		Appealed	
	Claims	Damage Incidents	Claims	Damage Incidents	Claims	Damage Incidents	Claims	Damage Incidents
Boom Area								
Oklahoma City	654	828	266	283	388	545	[illegible]	100
Chicago	1,409	1,469	1,409	1,469	(none)		[illegible]	28
Pittsburgh	1,049	1,158	490	513	559	645	[illegible]	114
Milwaukee	583	642	240	253	343	389	30	39
St. Louis†	452	497	204	224	248	273	24	25
Subtotal	4,147	4,594	2,609	2,742	1,538	1,852	[illegible]	306
FY66								
MAA	39	45	19	20	20	25	1	3
MOA	275	350	168	211	107	139	[illegible]	27
OCA	345	395	166	176	179	219	[illegible]	24
OOA	96	106	50	52	46	54	[illegible]	1
SAA	68	85	35	37	33	48	[illegible]	7
SMA	422	431	191	212	231	279	9	12
WPB	83	94	56	59	27	35	4	5
WRA	81	104	36	40	45	64	3	12
Subtotal	1,409	1,670	721	807	688	863	64	91
Edwards AFB‡	16	16	15	15	1	1	--	--
Total	5,572	6,280	3,345	3,564	2,227	2,716	[illegible]	397

* For files received prior to December 1966.

† July, August, September 1965 overflights.

‡ June 1966 overflights.

Many individual files contain claims for two or more damage types occurring to (or in) the same structure, possibly even at the same time. These alleged damage incidents are each based on their own merits, and if payments are made, they are related to a particular damage type. Table 2 shows number of incidents as well as number of claims. The table indicates that there are generally 10 percent more incidents for the five boom area cities than claims and 5 percent more paid incidents than paid claims.

Future prediction studies should probably be based on incidents with a conversion factor being used to estimate claims and claim handling costs.

Because the desired information was not always available from all the claims files, many of the tables in this report are necessarily based on a sample of the total incidents in the data bank. In these cases, the sample size includes all incidents for which the information in the table was obtainable. The sample size in each table is indicated in parentheses, either as a percentage or by the number of damage incidents on which the table is based.

IV CLAIMS IN GENERAL

IV CLAIMS IN GENERAL

Analysis of claims in general before reporting more detailed data serves in two important ways: (1) by using total claims as a partial reflection of how people react to sonic booms--which, in turn, causes handling costs that occur regardless of the validity of the claims--and (2) by allowing a reliability correlation between the paid claim sample used for subsequent analysis and the total of all claims.

Claim files were compared and summarized for the Pittsburgh, Milwaukee, and St. Louis boom areas and for FY66. The Oklahoma City and Chicago boom areas were not included in the comparison, because the use of only paid claims would not give an accurate overall view of the typical claim types.

Table 3 shows that most damage incidents involve single family structures. These account for three-fourths of all incidents. Commercial structures accounted for one-sixth of the claims, with multifamily, industrial, and other categories totaling less than 10 percent. Although the various percentages show comparative relationships, claim incidence should be related to the existing data base of each structure type. (Refer to Chapter VII.)

Table 3

CLAIMS IN GENERAL--USE OF STRUCTURES

	PBA	MBA	SBA	FY66	Total
(Damage Incidents)	(1,125)	(606)	(489)	(1,670)	(3,890)
Single family	77%	87%	80%	70%	76%
Multifamily	6	4	5	3	4
Commercial	13	7	10	22	16
Industrial	1	--	1	1	1
Other*	2	2	4	4	3

* Includes damage to objects other than buildings (e.g., automobiles, silos, cisterns, persons, animals.)

Of all structures, 84 percent were owner occupied and 16 percent occupied by lessees. This proportion (see Table 4) was reasonably consistent for all the boom areas and, in the case of claims involving single family residences, reflects a rate that claims are filed by owners three times that of lessees (considering data base of owners and lessees in the boom corridors).

Table 4
CLAIMS IN GENERAL--TYPE OF OCCUPANCY, AGE, AND CONDITION OF STRUCTURES

	PBA	MBA	SBA	FY66	Total
Occupancy					
Owner occupancy	83%	86%	89%	83%	84%
Lessee occupancy	17	14	11	17	16
(Sample Size)	(80%)	(86%)	(76%)	(88%)	(86%)
Age					
Newer than 25 years	39%	48%	49%	65%	52%
Older than 25 years	61	52	51	35	48
(Sample Size)	(74%)	(84%)	(90%)	(65%)	(74%)
Condition					
Dilapidated	11%	6%	12%	9%	10%
Fair	39	43	36	23	33
Sound	50	51	52	68	57
(Sample Size)	(79%)	(86%)	(85%)	(71%)	(77%)

The alleged sonic boom damage to structures was divided about equally between houses built before and after 1940--houses more or less than 25 years old. The percentage of houses in the less than 25 year old group is slightly lower for the Pittsburgh boom area and somewhat higher for the FY66 claims, probably reflecting the differing proportions of houses of this age group.

The condition of structures claimed to be damaged by sonic booms compares reasonably well for all areas, considering variations in age and human interpretations of "condition." Over half the structures were considered in sound condition, and only about 10 percent were considered in a dilapidated state.

More than 90 percent of the structures damaged were two stories or less (see Table 5), reflecting the large proportion of single family structures. The variation between one and two story structures suggests the inappropriateness of trying to distinguish between them. The Pittsburgh area had a significant percentage of alleged damages to three story structures. (Paid claims in Chicago indicated approximately 14 percent of the damage occurred in three story buildings.) This relatively high percentage of damage to three story structures in these areas is believed to be due merely to there being a higher percentage of tall buildings. No convenient way has been found to determine the census of buildings by height; however, the predominant floor of damage in multistory structures is worth noting. This is discussed later.

Table 5
CLAIMS IN GENERAL--HEIGHTS OF STRUCTURES

	PBA	MBA	SBA	FY66
One story	28%	41%	74%	71%
Two story	53	57	22	26
Three story	18	1	4	2
Four story	< 1	< 1	--	< 1
Five stories or more	1	< 1	< 1	< 1
(Sample size)	(79%)	(81%)	(90%)	(61%)

Of 3,890 incidents, no essentially predominant damage type was claimed. In looking at individual boom areas (Table 6), glass damage is seen to constitute the largest percentage in the Pittsburgh boom area and FY66. (Air Force Weekly Reports show 60 percent glass claimed in the Chicago boom area.) However, plaster is the largest damage type in the Milwaukee and St. Louis boom area.* Air Force Special Claims Offices reports show plaster is the predominant damage type in the Oklahoma City boom area, accounting for 65 percent of the total claimed damage.

* It is noted that both St. Louis and Milwaukee were subjected to intensive B-58 activity in 1961 and 1962, while Chicago and Pittsburgh were overflown for the first time in 1965.

Table 6

CLAIMS IN GENERAL--DAMAGE TYPES

	PAB	MBA	SBA	FY66	CBA*	OBA†
Glass	42%	28%	27%	49%	60%	8%
Plaster	25	42	46	21	21	65
Fallen objects	7	7	5	5	19	27
Miscellaneous	26	23	22	25		

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* Data from USAF Weekly Reports of sonic boom claims.

† Data from USAF Special Claims Offices Report for week ending 30 September 1965.

Also of note is the unusually low percentage of glass damage claimed in Oklahoma City; glass accounted for only 8 percent of the alleged damage there. Considering that Oklahoma City shared essentially the same ratio of claims-to-complaints (approximately 1 to 2) as the "B-58 cities" and believing that the ratios of glass surface to all other surfaces are about the same, this relatively low claim for glass damage points to the conclusion that glass in OBA was not as seriously affected as in the other cities.

Miscellaneous damage is consistent at approximately 25 percent for all boom areas. Percentages shown in Air Force reports for Oklahoma City and Chicago are believed to be somewhat higher (and therefore more consistent) because they are based on "claims" instead of "incidents" of damage. The miscellaneous category includes a wide variation of damage types. Structural damage, such as foundation cracks, cracks in brick and concrete walls, and frame misalignment, account for about half the incidents in this category. Other major damage in the miscellaneous category is to television sets (15 percent), bathroom fixtures (10 percent), ceramic tile (5 percent), and personal or animal injury (2 percent).*

Considering the damage types for single family and commercial structures separately (Tables 7 and 8), it is observed that for single family

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* Percentages obtained from a 10 percent sample of the miscellaneous incidents.

Table 7

CLAIMS IN GENERAL--SINGLE FAMILY STRUCTURE
DAMAGE BY TYPES

	PBA	MBA	SBA	FY66	Total
(Damage Incidents)	(860)	(525)	(392)	(1,172)	(2,949)
Glass	36%	23%	21%	39%	33%
Plaster	30	46	53	28	35
Fallen objects	7	7	4	5	6
Miscellaneous	27	23	22	28	26

Table 8

CLAIMS IN GENERAL--COMMERCIAL STRUCTURE
DAMAGE BY TYPES

	PBA	MBA	SBA	FY66	Total
(Damage Incidents)	(160)	(45)	(50)	(373)	(628)
Glass	71%	73%	77%	82%	78%
Plaster	6	9	12	3	5
Fallen objects	4	5	--	3	3
Miscellaneous	19	13	12	12	14

structures, glass, plaster, and other (miscellaneous and fallen objects) comprise almost equal percentages of the total damage. For the larger glass-paned commercial structures, however, glass is the predominant damage type, comprising over 70 percent of the damage in all areas. This partly explains the higher percentage of total glass damage in the Pittsburgh and FY66 claims, since these areas also have the highest percentage of alleged damage involving commercial structures.

The total averages shown in the tables are for illustrative purposes only. Care must be taken in their use, since such averages can often be misleading, as indicated by the large deviations in the individual areas for single family glass and plaster damage.

V COMPARISON OF PAID AND DENIED CLAIMS

V COMPARISON OF PAID AND DENIED CLAIMS

Comparison of paid and denied damage incidents for the Oklahoma City, Pittsburgh, Milwaukee, and St. Louis boom areas and FY 66 provides further insight into the representativeness of certain parameters when only the paid claims portion of the total claims history is used in making predictions. The comparison also tests the premise that paid claims are the most representative of cases reflecting possible-to-probable sonic boom causation.

The Chicago boom area was not included in this comparison, because the data bank contained only paid claims for that area. The Oklahoma City denials studied represent a 10 percent sample of the total denied incidents for that area.

As shown in Table 9, both the paid and denied damage incidents reflect high percentages involving single family structures, this percentage being

Table 9
PAID AND DENIED CLAIMS--USE OF STRUCTURES

	OBA		PBA		MBA		SBA		FY66	
	Paid	Denied	Paid	Denied	Paid	Denied	Paid	Denied	Paid	Denied
(Damage incidents)	(278)	(454)*	(502)	(623)	(246)	(360)	(221)	(268)	(807)	(863)
Single family	82%	91%	73%	80%	85%	88%	71%	83%	63%	76%
Multifamily	3	2	7	5	5	4	7	4	2	3
Commercial	15	5	20	10	10	5	17	5	30	15
Industrial	-	-	-	1	-	-	-	1	1	1
Other†	-	2	-	4	-	3	2	7	2	5

* Approximately 10% sample of the total denied incidents for Oklahoma City Boom Area.

† Includes damage to objects other than buildings, such as automobiles, silos, cisterns, people, and animals.

slightly higher for the denied incidents. The 2 to 3 times greater payment experience of incidents claimed by commercial owners and lessees is, no doubt, due to the predominance of glass damage in commercial structures--glass damage being the t[illegible] most easily attributed to sonic booms.

Although the 25 to 50 percent greater claims paid than denied in incidents involving multifamily structures might suggest greater validity of claims for damage to apartment houses, greater credibility given to lessee-claimants, to the higher incidence of glass damaged in multifamily structures, the relatively small percent of total damage indicated for this class of structure diminishes its relevance in prediction formulas. Similarly, the extremely small incidents of paid claims to industrial and "other" types (if any) would be of little concern. The denial of incidents involving broken glass in automobiles--damage generally considered not to be caused by sonic booms--accounts for most of the "other" category.

The type of occupancy and the age and condition of the structures appear to make little difference, whether a claim is in the paid or denied category. This is shown by Table 10, with approximately the same percentage of both paid and denied incidents falling in the "owner" and "newer than 25 years" categories.

Table 10

PAID AND DENIED CLAIMS--TYPE OF OCCUPANCY, AGE, AND CONDITION OF STRUCTURES

	OBA		PBA		MBA		SBA		FY66	
	Paid	Denied	Paid	Denied	Paid	Denied	Paid	Denied	Paid	Denied
Owner occupied	85%	92%	78%	86%	80%	88%	76%	83%	80%	86%
(Sample size)	(96%)	(96%)	(63%)	(94%)	(72%)	(97%)	(87%)	(92%)	(92%)	(84%)
Newer than 25 years	61%	56%	35%	40%	47%	50%	49%	48%	61%	68%
(Sample size)	(95%)	(97%)	(52%)	(92%)	(81%)	(90%)	(87%)	(94%)	(58%)	(72%)
Dilapidated	11%	17%	9%	12%	2%	10%	10%	15%	6%	11%
Fair	57	38	57	30	67	26	32	38	17	27
Sound	32	45	34	58	31	64	58	47	77	62
(Sample size)	(88%)	(97%)	(64%)	(93%)	(86%)	(87%)	(84%)	(85%)	(66%)	(82%)

Claims involving structures in fair condition appear to have a better chance of being paid than those involving structures in sound condition. This might cause speculation that where pre-existing damage or some deterioration is evident, there is a better chance for payment under the concept of triggering effect. Conversely, the sounder the structure, the more explicitly the damage must be defined in terms of probability before payment is justified. However, as mentioned before, the human difficulty in describing "condition," both at the investigator and data retrieval levels, leaves such statistics and conclusions suspect.

Distributions of damage types for paid and denied claims differ considerably. Table 11 shows, however, that although the distributions of damage types differ berween areas, the relationship between paid and denied claims follows the same trend in each area. In each case, the percentage of glass damage is considerably more for paid incidents--2.5 to 3.5 times the corresponding percentage for unpaid incidents. Fallen objects, although accounting for only a small percentage of the total damage incidents generally follow the same trend. On the other hand, the percentage of denied plaster damage is greater than paid damage by varying amounts (0.25 to 3 times) and the percentage for denied miscellaneous damages is 4 to 6 times that for paid claims.

Table 11
PAID AND DENIED CLAIMS--DAMAGE TYPES

	OBA		PBA		MBA		SBA		FY66	
Damage Type	Paid	Denied	Paid	Denied	Paid	Denied	Paid	Denied	Paid	Denied
Glass	38%	11%	71%	19%	47%	16%	44%	13%	72%	28%
Plaster	45	56	12	36	32	49	42	49	13	29
Fallen objects	11	1	10	4	13	3	7	3	6	4
Miscellaneous	6	32	7	41	8	32	7	35	9	39

This distribution is probably to be expected. Because of the greater possibility that a sonic boom may break glass or cause objects to fall (or at least these are more singularly overt to the claimant or investigator), it appears that these types of damage claims are generally paid. (Breakage of automobile windows, generally believed not to be due to sonic booms, accounts for part of the denied glass claims.)

Since tests have shown that sonic booms will not ordinarily cause new cracks in sound plaster and only occasionally aggravate existing cracks, it is reasonable to expect a larger proportion of the alleged plaster damage incidents to be denied, as has been the case. Generally, payment was made only in cases where sonic booms could have aggravated existing cracks or caused weakened plaster to fall. Many of the unpaid claims for plaster damage were found to be due to structural settlement, this being the reason for denial.

The types of damage that fall into the miscellaneous category differ between paid and denied claims. Damage to acoustical and ceramic tile, breakage of attached lamps and light fixtures, and injury to animals and people accounts for a large part of the paid miscellaneous claims, even though these types of damage were often denied. Miscellaneous claims denied were largely for structural damage (foundations, concrete slabs, brick walls, cisterns, and chimneys), damage to bathroom fixtures, or damage to appliances, mainly television sets. Tests have shown by and large that the nominal overpressures generally produced by the subject overflights cannot cause these types of damage. (Exceptions were a few low level flights in the FY66 data that produced overpressures up to 50 pounds per square foot and caused considerable damage of all types.)

Table 12 gives information on FY66 claims concerning the types of damage investigated or not investigated, those investigated being by Air Force personnel, engineers, and other investigators, and the statistical likelihood of payment for each type of damage by each type of investigator.

Glass was the largest damage type inspected by Air Force and "other" investigators. The largest percentage of engineer-investigated incidents were investigations for plaster and miscellaneous damage. This should probably be expected, since the Air Force uses engineers more often for these more difficult investigations.

As can be seen from the table, apparently no inspection was believed to be needed for 359 incidents. The reasons may be related to Air Force policy regarding payment of sonic boom damage claims. A large number of the incidents in this category were for glass window damage amounting to less than $20. If these incidents were adequately supported by evidence of cost of replacement and there was convincing evidence of Air Force causation, these claims were paid without requiring an investigation. Other reasons for not investigating are that some types of damage, such as certain structural damage or damage to automobile class and television sets, were not considered possible from sonic booms and would result in a denial of the claim, even if a field investigation were made. Exceptions to this would be such special cases as low level, high overpressure

Table 12

PAID AND DENIED CLAIMS--DAMAGE VERSUS INVESTIGATOR TYPES (FY66)

	Incidents Reported	Glass	Plaster	Fallen Objects	Miscel- laneous	All Damage Types
Percent of investigations made by:						
Air Force personnel*	(580)	57%	21%	6%	16%	
Engineer	(486)	26	34	2	38	
Other†	(97)	55	21	6	18	
No investigation	(359)	71	4	5	20	
Percent paid, where investigation was made by:						
Air Force personnel		74%	38%	51%	27%	57%
Engineer		60	29	36	21	34
Other		55	15	67	6	38
No investigation		72	31	63	7	57

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* Does not include Air Force engineers; these are included under "Engineer."

† Non-engineer, non-Air Force investigator.

flights. Also, no investigation was believed necessary if no Air Force plane capable of supersonic speeds was in the area at the time damage was claimed to occur. Thus, claims for which no investigation was made are of a special nature and should not be compared with claims that were investigated.

Table 12 also shows that all types of damages were paid more often when claims were investigated by Air Force personnel (non-Engineer) than when they were investigated by engineers. Although the incidents investigated by other investigators usually resulted in still lower payment rates

for each damage type, the sample was too small to be of much value. Also, because no information was available concerning the experience of the engineers and the Air Force investigators (who in some instances may be more qualified than some of the engineers), no conclusions could be drawn at this point concerning payment policy by types of investigators.

Because it was necessary to ensure that the claims used for prediction purposes represented the corridor of alleged damage reasonably accurately, one other comparison was made between paid and denied incidents. This involved the geographic distribution of paid and denied incidents for the Pittsburgh, Milwaukee, and St. Louis boom areas.

Table 13 indicates that the geographic distribution under the flight track in each of these three boom areas remained about the same for paid and denied incidents, with about half the damage occurring within corporate city limits, almost two-thirds in the greater city areas, and about 90 percent or more in a 20 mile corridor along the flight path. Accordingly, it can be concluded that there is little, if any, difference in the geographic distribution of claims, paid or denied.

Table 13

PAID AND DENIED CLAIMS--GEOGRAPHIC DISTRIBUTION OF INCIDENTS

	PBA		MBA		SBA	
	Paid	Denied	Paid	Denied	Paid	Denied
Corporate city only	44%	53%	49%	50%	47%	47%
Greater city area*	72	64	70	62	63	65
12 x 50 mile zone†	77	75	70	71	86	83
20 x 50 mile zone	85	83	78	77	91	90
12 mile corridor†	85	84	81	80	95	91
20 mile corridor	95	95	92	87	96	92

* Includes corporate city plus suburban fringe areas.

† See map, Figures 5 through 9, for graphical delineation.

In summary, although paid and denied incidents are similar, as far as type of occupancy, use, age, location, and condition of structures involved, they differ considerably in distribution of the types of damage. Since a high percentage of the denied claims were of types not generally believed attributable, or even remotely attributable, to sonic booms, it was believed that the impossible-to-improbable nature of these denied incidents should preclude their use with the paid incidents representing cases that reflect possible-to-probable sonic boom causation. Thus, only paid incidents are considered for the rest of the report.

VI PAID CLAIMS

VI PAID CLAIMS

As paid claims are considered the most likely representation of damage reflecting possible-to-probable sonic boom causation, they were used for a more detailed study in which all the data reported on the Supplementary Claims Record forms (see Appendix A) were examined. These data were summarized and evaluated for their usefulness in predicting future damage from the sonic boom. Two claim groups are considered--one covering the overflight programs (Oklahoma City, Chicago, Pittsburgh, Milwaukee, and St. Louis) and the other covering claims received by the Air Force during FY66. The first involved controlled flights over specific areas; the second involved damage claims due to random flights over numerous areas of the country.

The aircraft types used were primarily Century Series fighters in Oklahoma City (about 1 percent B-58 bombers) and B-58 bombers in the other four boom areas. Fiscal Year 1966 involved various types of planes; however, information on the type of aircraft was available for only 62 percent of the incidents. Of these, the percentages of the various types were: fighter aircraft (F-4, F-5, Century Series), 61 percent; B-58, 33 percent, B-70, 1 percent; SR-71 and YF-12, 4 percent; and T-38, 1 percent.

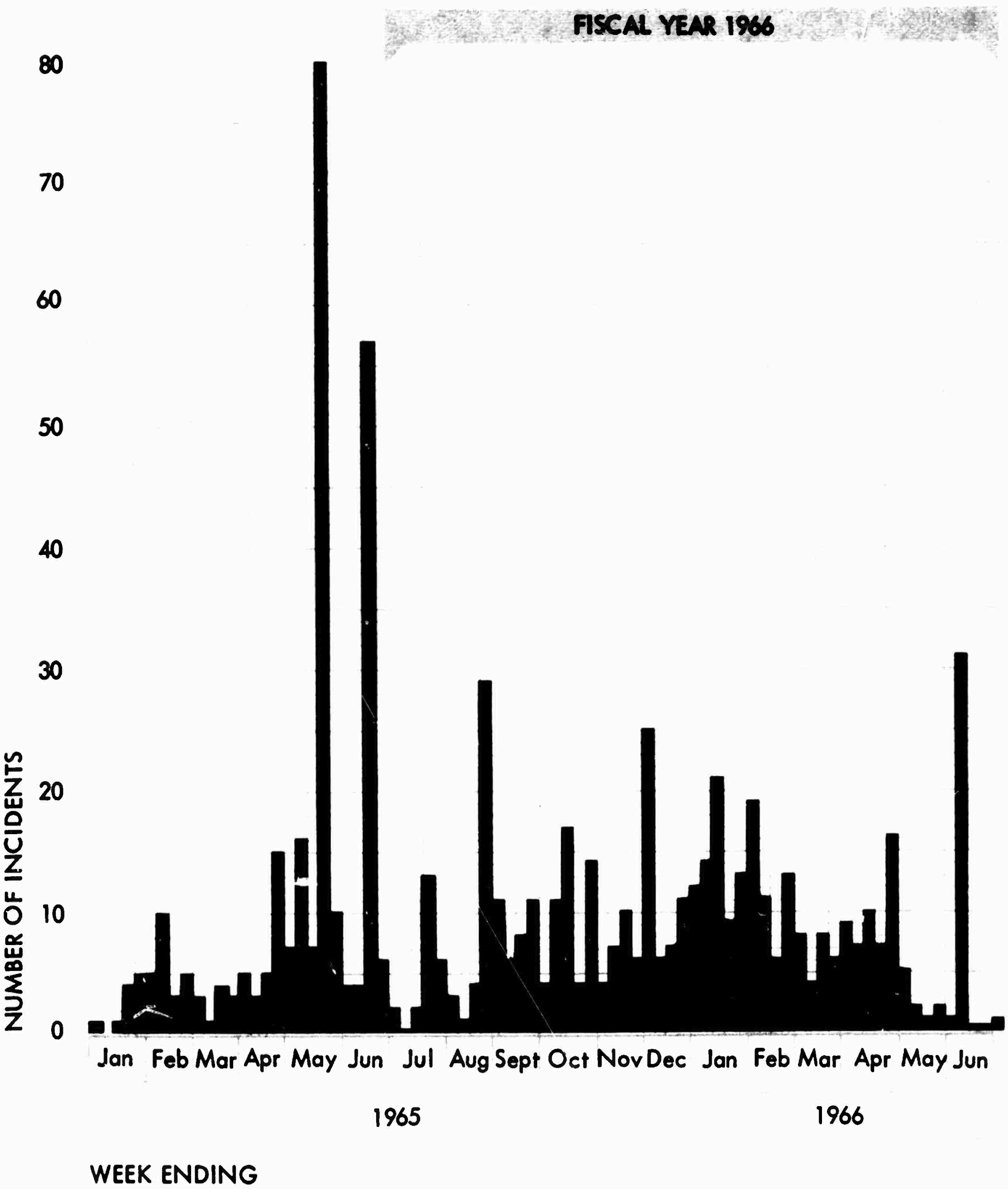
The Chicago, Pittsburgh, Milwaukee, and St. Louis overflights spanned three-month periods, while the Oklahoma City test lasted six months. Although filed during FY66, the claims include claims for damage from January 1965 to June 1966. Figure 3 shows the time-distribution of these incidents. Immediately evident are the high peaks during this period. The four highest are explained in part by the following:

1. 20-21 May 1965--Planned low level exercise (Redship 2) near Dover, Tennessee. There were at least three low level high intensity flights: an F-4C at 300 feet on 20 May and an F-4C and F-104 at 500 and 700 feet on 21 May. The data bank includes 76 paid incidents resulting from this exercise. (Seven were denied.)

2. 15 June 1965--Flight by unknown aircraft near Los Angeles. The data bank includes 24 paid incidents resulting from this flight. (Five were denied.)

Figure 3

FY66 PAID INCIDENTS BY DATE OF INCIDENCE



3. 27 August 1965--Flight by unknown aircraft near Los Angeles. The data bank includes 18 paid incidents on this date. (Nine were denied.)

4. 9 June 1966--An F-4C accidentally flew supersonically at 1,000 feet over Washington Court House, Ohio, a town of some 12,000. The flight, due to possible malfunction of the plane's machmeter, generated pressure estimated at 20 to 25 pounds per square foot. (Subsequent tests with the same aircraft indicated that a possible overpressure as high as 50 pounds per square foot could have occurred.) As of 13 December 1966, 196 claims have been filed, with 160 approved and 15 pending adjudication. The data bank includes 31 of these paid claims.

The curve in Figure 4 represents the accumulative effect of paid claim activity in the 18 months considered. The four "B-58 city" programs in 1965 are not included; therefore the curve essentially represents the paid claims rate of random Air Force supersonic flights across the United States. It is believed that the 49 percent of unpaid claims not included in this figure would not change the slope of the curve significantly. The average rate of approximately 11 incidents per week holds relatively constant during the 12 months of FY66. The decreasing rate during the last two months reflects the absence of data on early FY67 claim filings for incidents occuring during those months. Similarly, the lesser rate for the first five months is accounted for by the absence of claims filed in the latter part of FY65.

Areas subjected to controlled supersonic overflights consisted of many types of subareas, differing concentrations of people and structures, and differing classes of structures. To relate the existing data base to claims distribution, the paid incidents for the controlled overflight programs were plotted by location and their position determined with respect to the flight corridor and particular geographical areas. These plots are shown in Figures 5 to 9, and the results summarized in Table 14. The target cities incurred only half to two-thirds of the total damage, while approximately 65 to 90 percent was in the greater city area.* The exception was Oklahoma City, which incurred 92 percent of the damage in the corporate city limits and 97 percent in the greater city. This is no doubt due to the relatively rapid falloff of population density peripheral to the city area.

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* Due to the randomness of the FY66 flights, similar information is not possible for these cities.

Figure 4

FY66 ACCUMULATIVE TIME-DISTRIBUTION OF PAID INCIDENTS

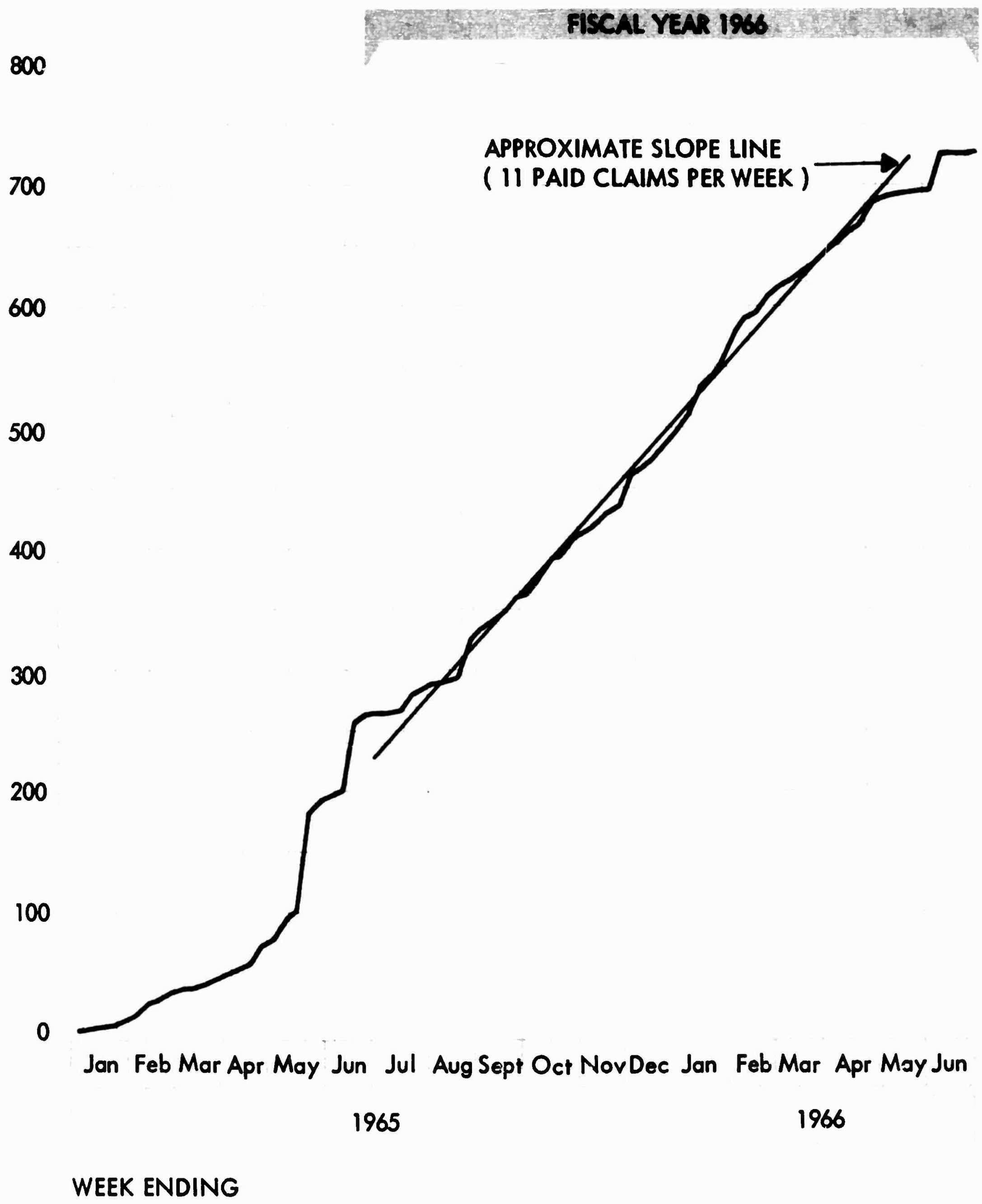


Table 14
PAID CLAIMS--GEOGRAPHIC DISTRIBUTION OF DAMAGE INCIDENTS

	OBA	CBA	PBA	MBA	SBA
City (Corporate city limits)	85%	67%	44%	49%	49%
Greater city area (City plus suburban fringe areas)	97	90	72	70	63
12 x 50 mile zone (12 miles wide by 25 miles up track and down track from approximate city center)	97	90*	77	70	86
20 x 50 mile zone (20 miles wide by 25 miles up track and down track from approximate city center)	100	93	86	78	92
12 mile corridor (12 miles wide along entire track)	98	90*	85	81	95
20 mile corridor (20 miles wide along entire track)	100	93	95	92	96

* 16 miles wide.

Because of this claims response from highly urbanized areas, conclusions that might be drawn from the data in this report should be considered slanted toward fairly dense areas. The response from rural areas and small cities geographically separated from metropolitan areas is unknown, either because the sample is too meager or because not enough controlled data are available regarding the number of overflying aircraft and their sonic boom characteristics.

From 92 to 100 percent of the damage occurred within a 20 mile corridor along the flight track, indicating that the path of greatest damage significance is 10 miles on each side of the flight track for similar planes flying at the speeds and altitudes flown in these programs. As previously

shown, this should be true for denied claims as well as paid claims. It is believed that the corridor of 92 percent or more damage would be in a path less than 20 miles wide, if the flight series could have been flown on a constant and precise track. In examining 22 tracks in Chicago, as an example, it was found that the series of aircraft not only varied in angular direction within the corridor but also laterally, up to several miles. The composite plotting of damage incidents therefore results in a widened scatter due to the wider "composite track."

In all of the following tables, percentage totals are given so that the experience of one boom area can be compared with the weighted average of all areas. No other use of "total" figures is intended at this point.

Table 15
PAID CLAIMS--USE OF STRUCTURES

	OBA	CBA	PBA	MBA	SBA	Total	FY66
(Damage Incidents)	(287)	(1,455)	(502)	(246)	(221)	(2,701)	(807)
Single family	82%	60%	73%	85%	74%	68%	63%
Multifamily	3	10	7	5	7	8	2
Commercial	15	29	20	10	17	24	30
Industrial	--	1	--	--	--	< 1	1
Other*	--	--	--	--	2	< 1	2

* Includes damage to objects other than buildings (e.g., automobiles silos, cisterns, persons, animals)

The percentage involving single family structures is fairly constant at about 70 percent of the total paid incidents (Table 15). Multifamily units, on the other hand, accounted for only up to 10 percent of the incidents. It is worth noting that even in Chicago, where apartment units roughly equal the number of single family residences, only 10 percent of the incidents were in multifamily structures. Commercial structures, although accounting for about one-quarter of the overall paid claims, vary widely with the boom areas. Percentages of FY66 incidents involving commercial structures are only slightly more than percentages of incidents in the controlled boom areas.

Figure 5

OKLAHOMA CITY BOOM AREA:
1241 Century Series Fighters and 12 B-58 Sonic Booms in 167 Activity Days (7.5 per day)

FEB THRU JULY 1964

277 INCIDENTS OF DAMAGE:
82% SINGLE-FAMILY
3% MULTIPLE FAMILY
15% COMMERCIAL

(NOTE: DATA TO 1 MARCH 66)

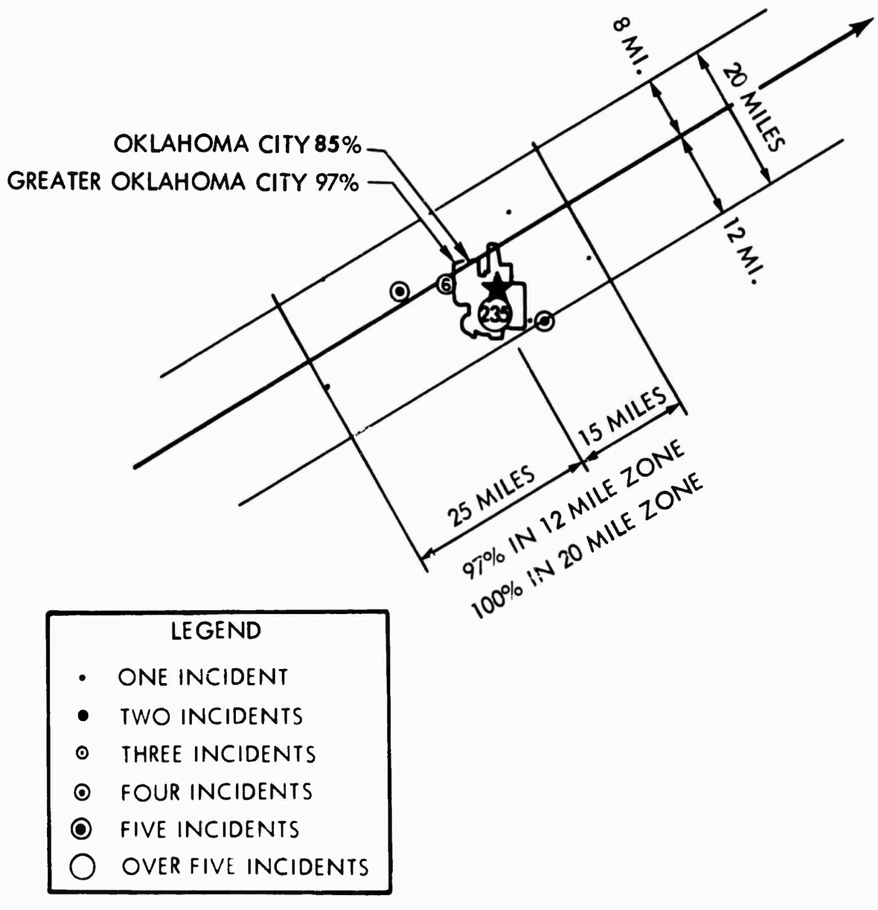


Figure 6

CHICAGO BOOM AREA:
49 B-58 Sonic Booms in 38 Activity Days (1.3 per day)

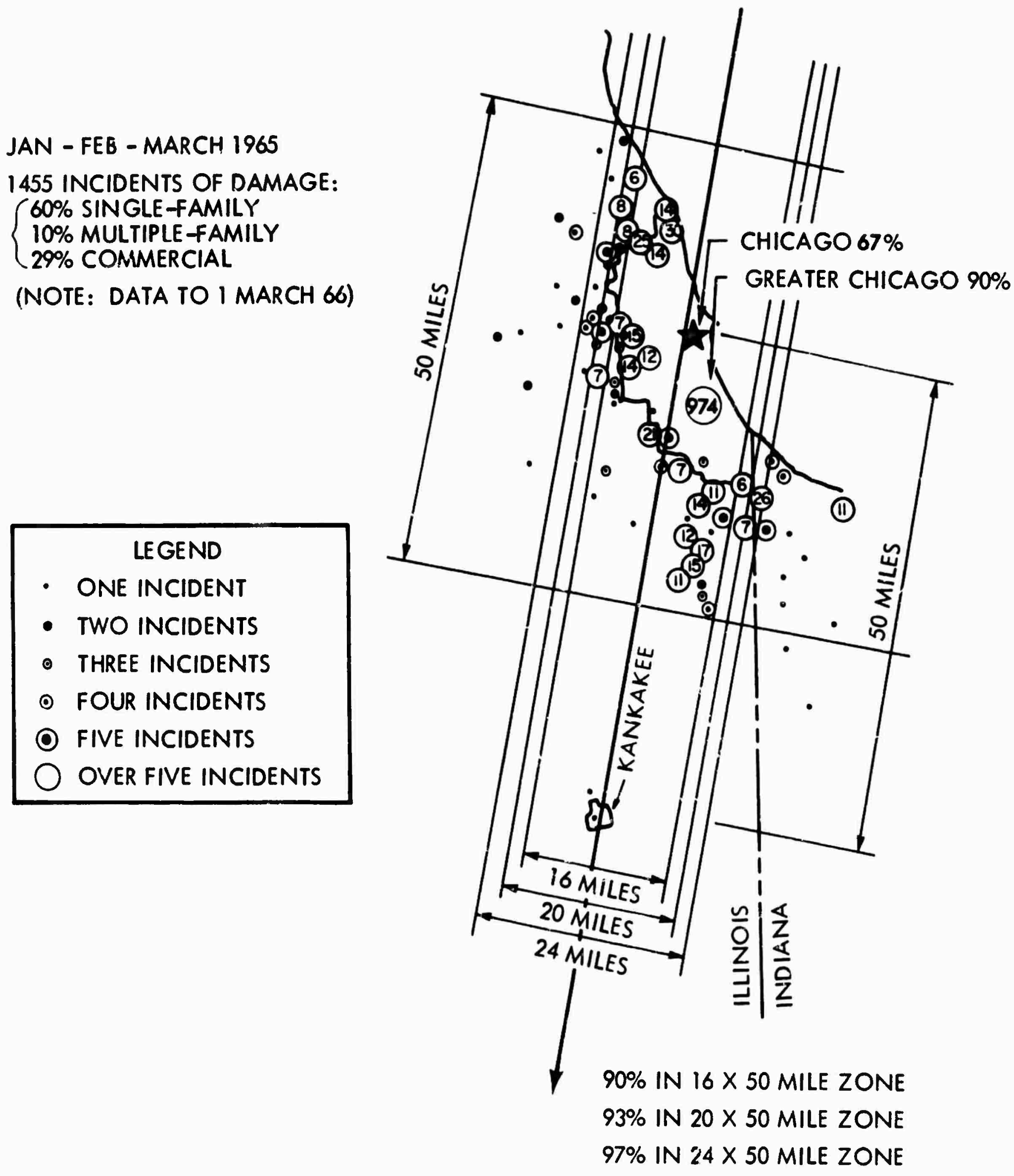


Figure 7

PITTSBURGH BOOM AREA:
50 B-58 Sonic Booms in 39 Activity Days (1.3 per day)

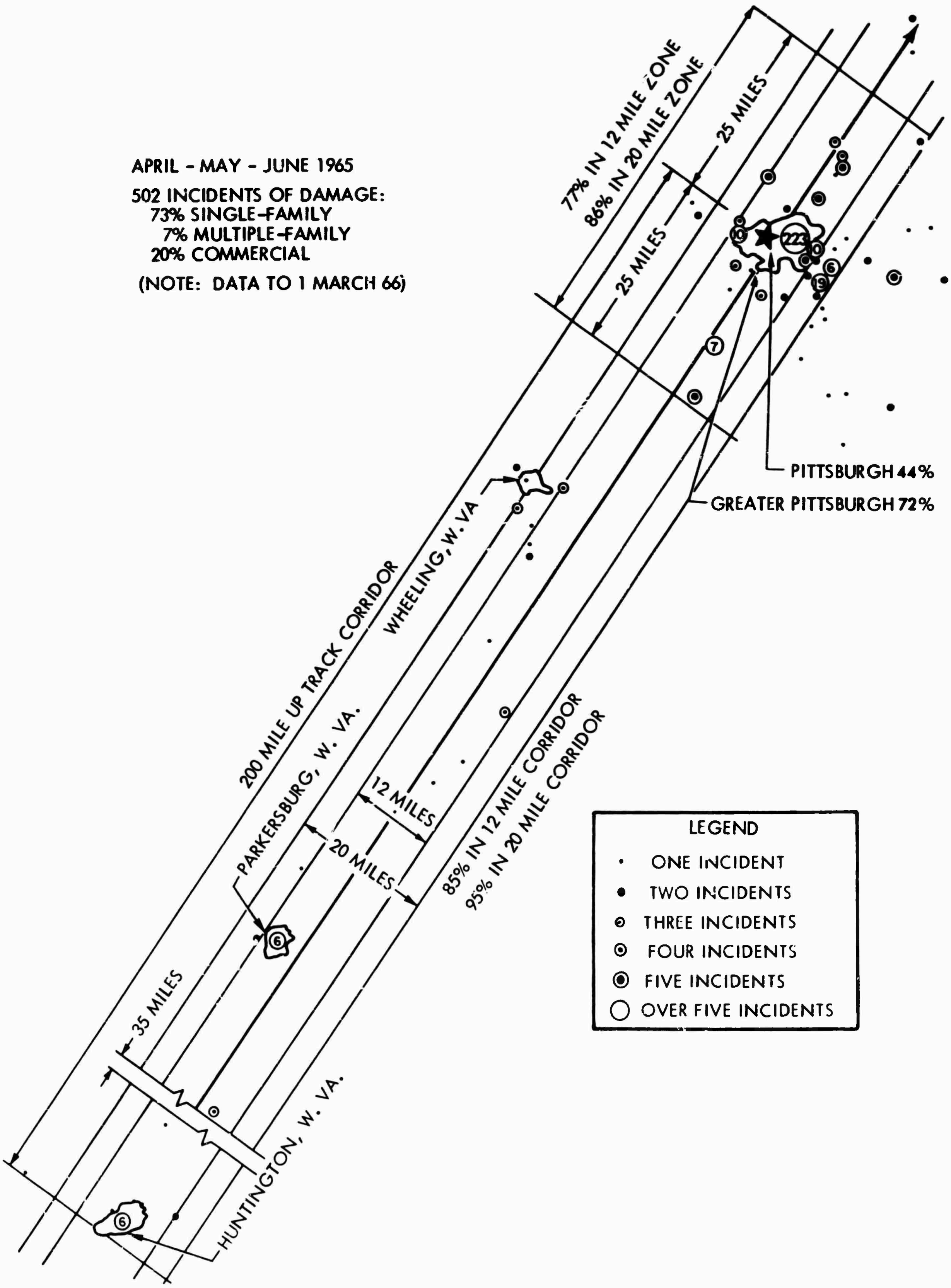


Figure 8

MILWAUKEE BOOM AREA:
61 B-58 Sonic Booms in 41 Activity Days (1.5 per day)

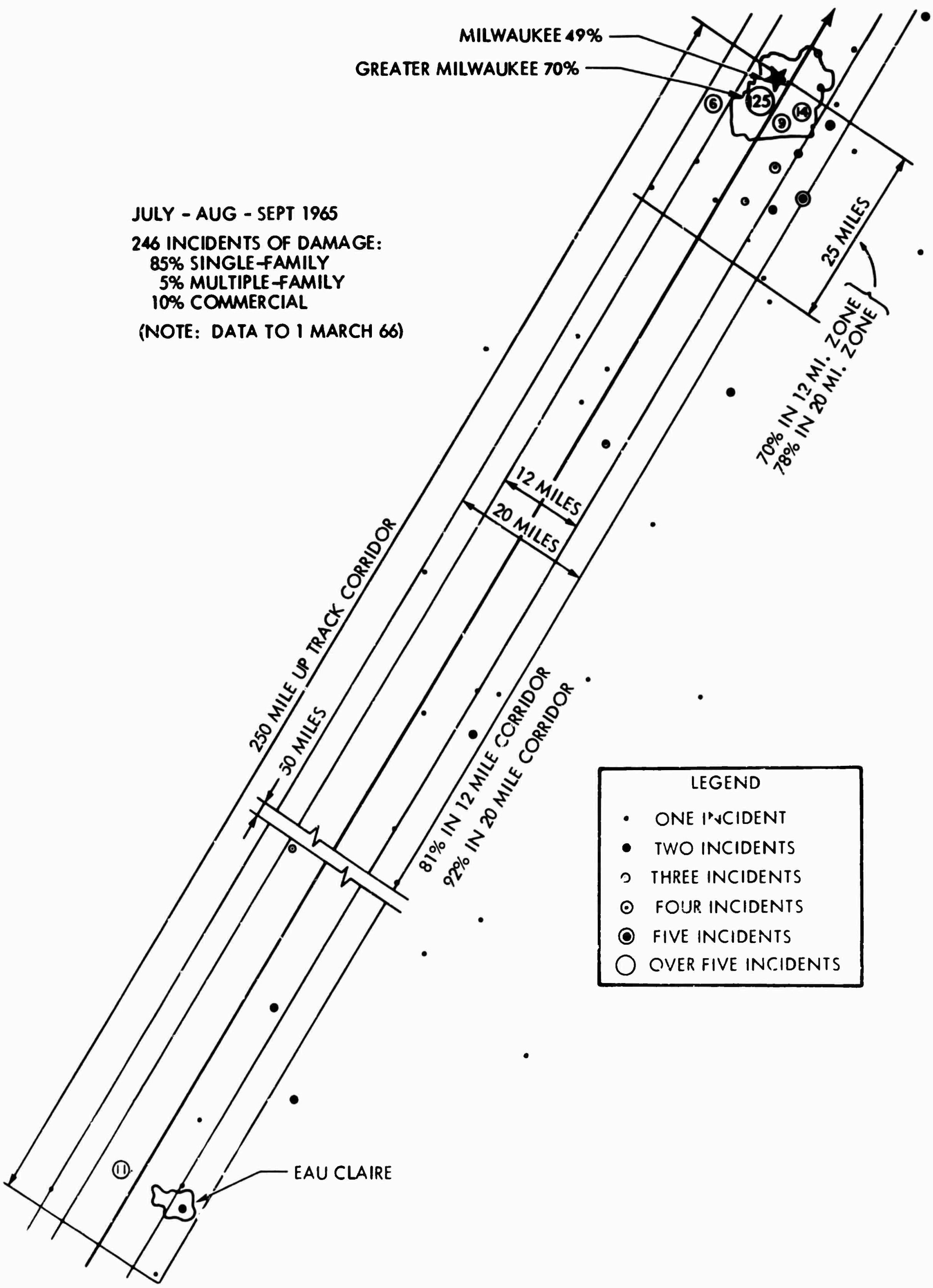
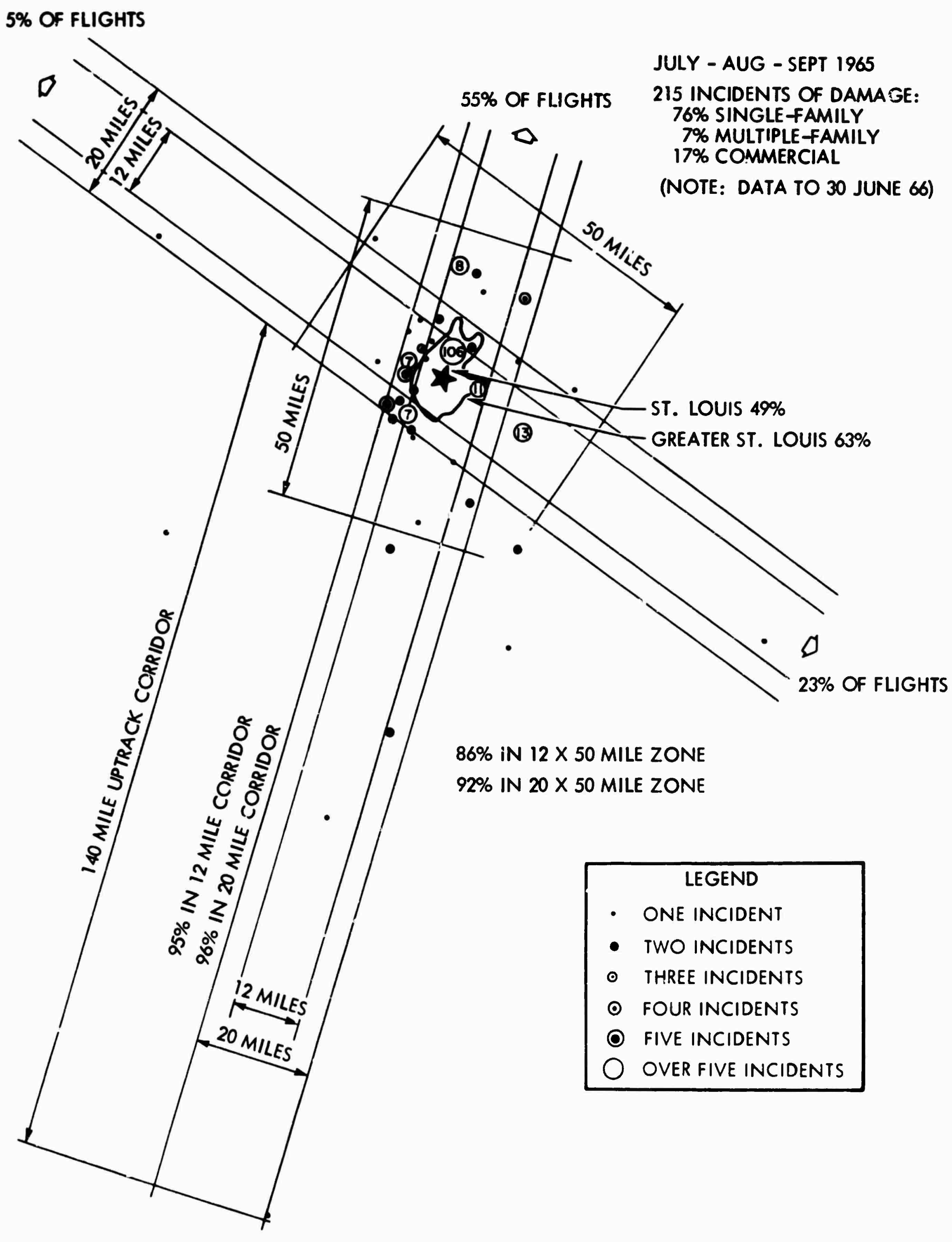


Figure 9

ST. LOUIS BOOM AREA:
22 B-58 Sonic Booms in 20 Activity Days (1.1 per day)



Considering type of occupancy, age, and condition of structures for the paid incidents, about 80 percent of the structures involved are owner-occupied (Table 16). Paid damage was about equal, regardless of whether the houses were more or less than 25 years old. And more than 90 percent were in fair or sound condition. Again, to be significant, these figures need to be compared with the data base of existing structures. When this is done, as in Chapter VII, it is found that owners claim sonic boom damage about 3 times more often than lessees and that claim rates involving structures newer than 25 years old are about 1.5 times greater than for older structures.

Table 16
PAID CLAIMS--TYPE OF OCCUPANCY, AGE, AND CONDITION OF STRUCTURES

	OBA	CBA	PBA	MBA	SBA	Total	FY66
Owner occupied	85%	75%	78%	80%	76%	78%	80%
(Sample size)	(96%)	(72%)	(63%)	(72%)	(87%)	(77%)	(92%)
Newer than 25 years	61%	41%	35%	47%	49%	45%	61%
(Sample size)	(95%)	(72%)	(52%)	(81%)	(87%)	(73%)	(57%)
Dilapidated	11%	7%	9%	2%	10%	8%	6%
Fair	57	45	57	67	32	51	17
Sound	32	48	34	31	58	41	77
(Sample size)	(88%)	(36%)	(64%)	(86%)	(84%)	(55%)	(66%)

Fiscal Year 1966 paid incidents reflect about the same percentage of owner occupied structures as boom area cities. However, the percentage of houses newer than 25 years old is greater for FY66, and the houses in sound condition increase by a significant amount. Both increases no doubt merely reflect the larger percentage of newer homes situated in newer areas, such as the West and Southwest, that experienced sonic booms in the last half of FY65 and FY66.

Overall, glass is the predominant damage type, with nearly three-fourths of the paid incidents for Chicago, Pittsburgh, and FY66 being glass damage (Table 17). Oklahoma City and St. Louis are exceptions, however, with plaster predominant or constituting nearly the same percentage of damage as glass. Although the percentage of paid glass incidents in Oklahoma City is relatively low, it is a comparative increase

over the rate of glass claims filed there (8 percent of all claims). Table 18 indicates that the statistical likelihood of payment for a glass claim in Oklahoma City was about 1 in 4 as compared with 1 in 20 to 30 for other types of damage.

Table 17
PAID CLAIMS--DAMAGE TYPE

	OBA	CBA	PBA	MBA	SBA	Total	FY66*
Glass	38%	75%	71%	47%	44%	65%	72%
Plaster	45	14	12	32	42	21	13
Fallen objects	11	6	10	13	7	8	6
Miscellaneous	6	5	7	8	7	6	9

* The FY66 figures in this table include incidents involving the low level overflights in Dover, Tennessee, and Washington Court House, Ohio. If these are neglected, due to their possibility of not being considered representative of the type of damage caused by the lower intensity overflights otherwise the case, the percentages change only slightly. The percentages for plaster and fallen objects remain the same, while the percentages of glass damage increases to 75 percent and miscellaneous damage decreases to 6 percent.

Table 18
PAID CLAIMS--PERCENTAGE PAID
ACCORDING TO TYPE OF DAMAGE

	OBA	CBA	PBA	MBA	SBA
Glass	27%	65%	75%	58%	77%
Plaster	4	26	24	31	39
Other	3	23	29	43	25

Miscellaneous incidents in all areas constitute less than one-tenth of the paid incidents (Table 17), while they account for one-fourth of the total claimed damage. This reflects the low number of miscellaneous incidents believed due to sonic booms. The percentage of plaster damage also falls, from 29 percent of total incidents to 21 percent paid incidents. This reduction is due to the belief that sonic booms will generally not cause new cracks in sound plaster and only on occasion aggravate existing cracks. Table 19 reflects this premise in showing that three-fourths of the paid plaster incidents are for aggravated damage. Percentages of plaster damage in FY66 support almost identically the results from the controlled overflight boom areas: that the majority of paid plaster incidents are for aggravated damage.

Table 19
PAID CLAIMS--AGGRAVATED AND PROGRESSIVE PLASTER DAMAGE

	OBA	CBA	PBA	MBA	SBA	Total	FY66
(Paid plaster incidents)	(124)	(198)	(60)	(78)	(95)	(555)	(87)
Aggravated*	74%	70%	63%	83%	87%	75%	74%
New†	15	23	35	8	10	18	18
Unknown‡	11	7	2	9	3	7	8

* Pre-existing cracks, water damage, improper installation, spalled keys, or other evidence found.

† No evidence of pre-existing unstable or prestressed conditions observed. General soundness of structure and freedom from imperfections or other damage noted.

‡ Insufficient data in file or comment by investigator to classify.

Of the paid glass damage incidents (Table 20), approximately 40 percent were of an unknown nature--Type 1 (either completely shattered or replaced before investigation). For those in which the type of breakage was known, Type 2 (horizontal, vertical, or random cracks from the edge or radiating from the center) was clearly the predominant type. Type 3 (breakage across the corners or at the corners) accounted for only a small portion of the paid glass incidents. This would probably be expected since this Type 3 breakage is more generally associated with foundation settlement and would likely not be paid. Type 6 (horizontal, vertical, and random cracks extending from the edge or center of the wall) are also

the predominant type of plaster damage. Type 7 (cracks radiating from the corners or along angle joints or seams), again generally associated with foundation settlement, and Type 5 (fallen plaster damage) account for about equal portions of the remaining damage.

Table 20
PAID CLAIMS--GLASS AND PLASTER DAMAGE BY TYPE

	Glass Breakage*				Plaster Damage*		
	Type 1	Type 2	Type 3	Type 4	Type 5	Type 6	Type 7
Boom areas	40%	44%	13%	3%	24%	55%	21%
FY66	42	50	5	3	26	46	28

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* See Appendix A for definition and sketch of descriptors; Type 1 includes Types 12, 13, 14; Type 2 includes Types 22, 23, 24; etc.

It is believed that greater reconciliation of the apparent differences in the cities can be achieved by isolating certain parameters, especially where parameters vary with census data. The significance of single family structures and commercial establishments, as compared to the relative insignificance of multifamily structures, suggests such a segregation of data. Tables 21 and 22 show the occurrence of damage reported in single family structures and in commercial establishments. Other than possibly to indicate the marked percentage increase of glass damage in commercial structures, the important use of this type of data is in relating particular damage to varying populations of different structures (discussed in Chapter VII).

Table 21
PAID CLAIMS--SINGLE FAMILY STRUCTURES

	OBA	CBA	PBA	MBA	SBA	Total	FY66
(Paid incidents)	(227)	(875)	(365)	(208)	(168)	(1843)	(518)
Glass	31%	67%	66%	40%	34%	56%	63%
Plaster	52	19	15	36	50	27	20
Fallen objects	21	8	11	15	8	10	7
Miscellaneous	5	6	8	9	8	7	10

Table 22
PAID CLAIMS--COMMERCIAL STRUCTURES

	OBA	CBA	PBA	MBA	SBA	Total	FY66
(Paid incidents)	(43)	(430)	(100)	(27)	(37)	(637)	(253)
Glass	82%	93%	90%	96%	86%	92%	93%
Plaster	2	1	1	--	--	1.5	1
Fallen objects	4	1	4	--	--	1.5	2
Miscellaneous	12	5	5	4	3	5	4

Table 23, however, offers one possible explanation for this marked influence of glass damage to commercial establishments. Glass greater than 4 feet in minimum dimension accounts for nearly 90 percent of the commercial glass breakage, while 2- to 4-foot glass comprises the largest percentage for single family homes. The larger size window generally found in commercial structures has a greater possibility of being broken by resonance, since its lower natural frequency coincides more closely to that of the sonic boom wave.

Table 23
PAID CLAIMS--GLASS SIZE

	OBA	CBA	PBA	MBA	SBA	Total	FY66
Single Family							
(Incidents reported)	(67)	(574)	(232)	(76)	(50)	(999)	(297)
Less than 2 feet*	21%	26%	25%	29%	42%	27%	27%
2 to 4 feet	72	55	65	63	46	58	56
Greater than 4 feet	7	19	10	8	12	15	17
Commercial							
(Incidents reported)	(35)	(392)	(110)	(26)	(32)	(595)	(226)
Greater than 4 feet	83%	87%	82%	73%	91%	87%	87%

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* All dimensions are measured in the minimum direction.

It was noted in Interim Technical Report 2 that in Oklahoma City, Chicago, Pittsburgh, and Milwaukee approximately two panes were damaged for each single family glass incident. St. Louis averaged three panes per incident. Fiscal Year 1966 single family glass incidents averaged about three panes, agreeing with previous values.

The significance of damaging an average of two or three windows in a given number of structures as opposed to damaging the same number of windows in, say, two or three times the number of structures is not too clear. It does appear that of the millions of individual window elements in the "glass population" actually subjected to boom overpressure, most all were left unaffected but that when there was damage, breakage occurred in multiples.

Further, assuming that window mountings are more similar in individual structures than in a mixture of structures, a conclusion might be drawn that it is the structure (or a portion of a structure) that reacts as a preconditioned spatial frame to the sonic boom phenomena, not the window frame and certainly not the glass pane itself. Thus, the window frame and glass manifest only a secondary or consequential type damage. If this is the reason for multiwindow damage in essentially isolated structures scattered throughout the boom corridor, the importance of the structural frame as opposed to the damaged window element could bear more weight in structural dynamic response from sonic boom.

Alternatively, selectivity of the boom wave toward the glass elements in certain randomly located structures might be the result of boom strengthening perturbations varying in a rapidly changing manner and caused by atmospherics; surface boundary layers; topography; building size, shape, and orientation; presence of reflecting surfaces, proximity to other buildings, and so forth.

Information recorded on FY66 glass incidents included the material in which the broken panes were mounted and whether the window was fixed, hinged, or sliding. This information was available for 53 percent of the paid glass incidents, although it cannot be related to an existing data base. The results are shown in Table 24.

Metal mountings (aluminum, steel, and other metals) account for about three-fourths of the glass incidents. This coincides with the previous finding that 63 percent of the paid incidents occurred in structures built after 1940, metal frames having come into significantly greater use since that time. Three-fourths of the damaged windows were in fixed mountings. This can be explained in part by commercial structures; although comprising only about half the total sample, they account for 73 percent of the "fixed" category and only three incidents occurred in each of the sliding and hinged categories.

Table 24
PAID CLAIMS--WINDOW MOUNTINGS

	Fixed	Sliding	Hinged	Unknown	Total
Wood frame	22	26	3	9	60
Aluminum frame	39	19	3	20	81
Steel frame	4	1	--	--	5
Metal frame*	67	8	4	5	84
Unknown	72	6	1		
Incidents reported	204	60	11		

* Exact metal type undeterminable from claims file.

Information is not available on the proportions of window types in the data base overflown. Subject to this shortage of information, it can be conjectured that as the rigidity of the mounting increases--from hinged to sliding to fixed--the greater the possibility of breakage from sonic boom overpressures. Again, it may be the structural frame supporting the window mounting, instead of the glass or even the window frame itself, that is causing the glass damage. This, with the larger window sizes, may account for the high rate of damage found for commercial structures. Certainly, it is an area in which further study is warranted.

Most of the damage in single family houses occurred to those of wood frame construction, with only St. Louis showing a slightly larger percentage of masonry construction being damaged (Table 25). The frame category consists primarily of wood siding and brick veneer types, the brick veneer comprising a slightly higher proportion. Brick structures account for almost the entire masonry category. Variations in the areas could be due mainly to the different percentages of construction types in the total base of houses exposed, but no valid data base relationships have been found so far.

Table 25

PAID CLAIMS--CHARACTERISTICS OF SINGLE FAMILY STRUCTURES

	OBA	CBA	PBA	MBA	SBA	Total
Wood frame	94%	70%	67%	79%	44%	73%
Masonry	5	30	31	14	52	25
Combination	1	< 1	2	7	4	2
(Sample size)	(93%)	(64%)	(51%)	(76%)	(52%)	(66%)

A slightly higher percentage of damage to houses of wood frame construction is shown for FY66 than for the five boom areas (Table 26). All Air Materiel Areas, except WRA, reflect this high percentage. The sample sizes in a few areas are small, however, and care must be taken in using them. From this, it might be concluded that if FY66 incidents are a fair representation of damage types across the country, alleged or otherwise, and even with rough assumptions about different construction types overflown, claims activity--all other things being equal--would increase as the population of wood frame structures increases and the level of masonry structures remains static or decreases.

Table 26

PAID CLAIMS--CHARACTERISTICS OF SINGLE FAMILY STRUCTURES (FY66)

	MAA	MOA	OCA	OOA	SAA	SMA	WPB	WRA	Total
Wood Frame	90%	84%	80%	100%	100%	70%	78%	29%	80%
Masonry	10	15	17	--	--	19	22	57	16
Combination	--	1	3	--	--	11	--	14	4
(Sample size)	(83%)	(43%)	(38%)	(38%)	(11%)	(25%)	(30%)	(18%)	(35%)

Table 27 compares the floors of damage and the heights of the structures damaged. The greater percentage of damage usually occurs on the first floor, regardless of the height of the structure. However, the rate of damage decreases on the first floor and increases with height up to

the fourth floor. Above four stories, the sample was too small to be of value.

Table 27

P/ CLAIMS--FLOORS OF DAMAGE AND HEIGHTS OF STRUCTURES
(All Boom Areas Including FY66)

Height	No. of Structures*	1st	2nd	3rd	4th	5th	6th	Other (Specify)
1	1,256	100%						
2	646	74	28%					
3	176	59	15	26%				
4	14	50	14	14	22%			
5	10	70	10	--	10			
6	6	17	17	33	--	--	33%	
7	2	50	--	--	50			
8	2	50	50					
9	1	100						
10	1	100						
13	1							100% (12th)
14	1	100						
15	3	67	33					
16	1			100				
17	1	100						
18	2	50						50 (12th)
40	1							100 (39th)

* Includes only structures for which the specific floor of damage was known.

Table 28 shows the types of aircraft related to the type of paid damage for incidents filed in FY66. As previously suggested, one possible explanation for the comparatively low percentage of glass damage in Oklahoma City is that fighter aircraft were used instead of B-58 bombers as were used elsewhere. However, FY66 incidents related to these two types of aircraft do not appear to support such a contention; instead the 62 percent sample of known aircraft shows approximately equal percentages of glass damage for fighters and bombers. Also, the percentages for other damage types (except fallen objects) are nearly the same. Thus, differences in the two types of aircraft appear to have had little effect on the types of damages that were paid.

Table 25

PAID CLAIMS--CHARACTERISTICS OF SINGLE FAMILY STRUCTURES

	OBA	CBA	PBA	MBA	SBA	Total
Wood frame	94%	70%	67%	79%	44%	73%
Masonry	5	30	31	14	52	25
Combination	1	< 1	2	7	4	2
(Sample size)	(93%)	(64%)	(51%)	(76%)	(52%)	(66%)

A slightly higher percentage of damage to houses of wood frame construction is shown for FY66 than for the five boom areas (Table 26). All Air Materiel Areas, except WRA, reflect this high percentage. The sample sizes in a few areas are small, however, and care must be taken in using them. From this, it might be concluded that if FY66 incidents are a fair representation of damage types across the country, alleged or otherwise, and even with rough assumptions about different construction types overflown, claims activity--all other things being equal--would increase as the population of wood frame structures increases and the level of masonry structures remains static or decreases.

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Wood Frame	90%	84%	80%	100%	100%	70%	78%	29%	80%
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Combination	--	1	3	--	--	11	--	14	4
(Sample size)	(83%)	(43%)	(38%)	(38%)	(11%)	(25%)	(30%)	(18%)	(35%)

Table 27 compares the floors of damage and the heights of the structures damaged. The greater percentage of damage usually occurs on the first floor, regardless of the height of the structure. However, the rate of damage decreases on the first floor and increases with height up to

the fourth floor. Above four stories, the sample was too small to be of value.

Table 27

PAID CLAIMS--FLOORS OF DAMAGE AND HEIGHTS OF STRUCTURES

(All Boom Areas Including FY66)

Height	No. of Structures*	1st	2nd	3rd	4th	5th	6th	Other (Specify)
1	1,256	100%						
2	646	74	28%					
3	176	59	15	26%				
4	14	50	14	14	22%			
5	10	70	10	--	10			
6	6	17	17	33	--	--	33%	
7	2	50	--	--	50			
8	2	50	50					
9	1	100						
10	1	100						
13	1							100% (12th)
14	1	100						
15	3	67	33					
16	1			100				
17	1	100						
18	2	50						50 (12th)
40	1							100 (39th)

* Includes only structures for which the specific floor of damage was known.

Table 28 shows the types of aircraft related to the type of paid damage for incidents filed in FY66. As previously suggested, one possible explanation for the comparatively low percentage of glass damage in Oklahoma City is that fighter aircraft were used instead of B-58 bombers as were used elsewhere. However, FY66 incidents related to these two types of aircraft do not appear to support such a contention; instead the 62 percent sample of known aircraft shows approximately equal percentages of glass damage for fighters and bombers. Also, the percentages for other damage types (except fallen objects) are nearly the same. Thus, differences in the two types of aircraft appear to have had little effect on the types of damages that were paid.

Table 28

PAID CLAIMS--DAMAGE TYPES AND AIRCRAFT (FY66)

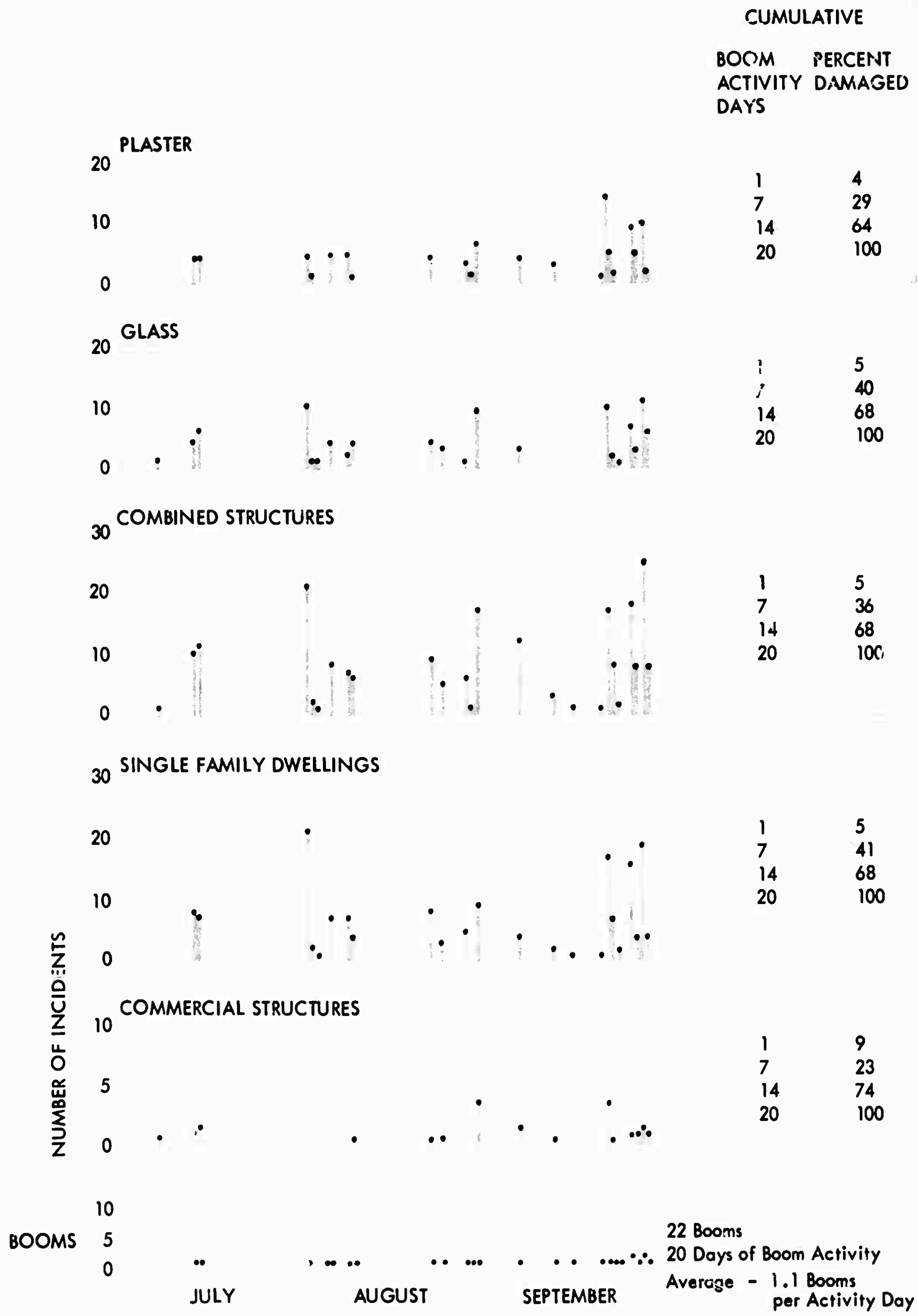
	Incidents Reported*	Glass	Plaster	Fallen Objects	Miscel-laneous
F-4, F-5, Century Series fighters	(189)	76%	14%	1%	9%
B-58	(164)	68	18	8	6
B-70	(5)	40	20	20	20
SR-71, YF-12	(19)	74	5	5	16
T-38	(6)	33	33	33	--

* Does not include incidents reported from Washington Court House, Ohio, and Dover, Tennessee.

Damage plotted by date of incidence for the St. Louis boom area is shown in Figure 10. This corresponds to Appendix Figures F-16 through F-21. St. Louis did not show the same marked reduction and leveling off of the damage rate after the first day (first week for Oklahoma City) that the other boom areas did. This is no doubt due to nine of the 22 booms occurring during the last eight days of activity. Detailed data similar to those presented in the previous report for other boom areas appear for the 1965 St. Louis overflight program in Appendix Figures B-13, B-14, and B-15.

Figure 10

DAMAGE VERSUS DATE OF INCIDENT -- St. Louis Boom Area



VII RELATION OF PAID CLAIMS TO DATA BASE

VII RELATION OF PAID CLAIMS TO DATA BASE

Tables 15, 16, and 25 in Chapter VI show use, age, type of occupancy, condition, and building characteristics of structures for which sonic boom damage was claimed and paid. However, this information in itself is of little value for prediction of future sonic boom damage. To be meaningful, the data must be compared with the actual number of structures subjected to the sonic booms. For the following tables, the base against which the claims information is compared was obtained from U.S. Census of Housing-1960 and 1963 Business Census adjusted to boom year values by extrapolating from 1950-60 growth rates. Only incidents occurring within the greater city area (which constitute 63 to 90 percent of the paid incidents) are used. The population (structures) base for outlying suburbs and rural areas can be included in the future by using a computer program accommodating census data storage. In the meantime, however, data in the tables show results that are explicit for highly urbanized areas and that are only indicative for less densely populated outlying areas.

Table 29 shows the percentages of paid damage incidents involving single family, multifamily, and commercial structures. Percentages of the total living and business units comprising single family, multifamily, and commercial structures are also shown. Two unit (duplex) dwellings are considered as single family structures (using the same basis as the raw data) and commercial units are considered wholesale, retail, and service establishments, as defined in census data. The percentage of single family damage incidents corresponds relatively well with the percentage of existing single family structures. Multifamily incidents, however, constitute a considerably lower percentage of total incidents than the percentage of existing multifamily units would indicate.

Commercial establishments, on the other hand, while only 5 percent of the existing units, account for from 7 to 31 percent of the damage incidents. The ratios of single-to-multiple-to-commercial incidents show the damage to multifamily units at a rate approximately 0.3 that of single family units, while damage to commercial establishments occurred at a rate averaging three to four times that of single family structures.

The low rates for multifamily units are believed to be partially because apartment houses, particularly larger ones, are generally better

Table 29
USE OF STRUCTURES (DATA BASE)

	OBA	CBA	PBA	MBA	SBA
Single family					
Incidents	82%	59%	72%	86%	67%
Structures	85	46	75	75	60
Multifamily					
Incidents	3	10	10	7	10
Units	10	49	20	20	35
Commerical					
Incidents	15	31	18	7	21
Establishments	5	5	5	5	5
Taking the ratio of single family incidents to single family structures as unity, the ratio of single-to-multiple-to-commerical paid damage incidence rates would be	1.0:0.3:3.1	1.0:0.2:4.8	1.0:0.5:3.7	1.0:0.3:1.2	1.0:0.3:3.7

constructed and thus not as susceptible to sonic boom damage as single family structures. Another factor, discussed later, is that nearly all the occupants are lessees and are probably not as observant or concerned with the condition of the structure as owners would be. The high paid damage rate for commercial establishments may be related to the high percentage of glass incidents. The larger windows in business establishments are generally more susceptible to breakage from sonic booms.

The age of structures damaged is compared to the existing data base in Table 30. (Information on the age of commercial structures was not available.) The breaking point of 25 years is used only to determine general trends in the age of structures for which damage has been paid. Other information, such as damage to relatively new construction (say within 10 years) can easily be obtained from the data bank. The 25 year figure, which corresponds to 1940, makes it possible to distinguish between pre- and post-World War II construction.

Table 30
AGE OF STRUCTURES* (DATA BASE)

	OBA	CBA	PBA	MBA	SBA
Newer than 25 years					
Damage incidents	58%	49%	41%	48%	52%
Existing housing units†	61	24	36	46	24
Older than 25 years					
Damage incidents	42	51	59	52	48
Existing housing units	39	76	64	54	76
Taking the rate of incidents-to-housing units for construction older than 25 years as unity, the ratio of newer than 25 years to older than 25 years paid damage incidence rates would be	0.9:1.0	3.0:1.0	1.2:1.0	1.1:1.0	3.4:1.0

* Single and multifamily units only.
† Includes estimate of units built from 1960 to year of overflights.

Damage incidents occurring to both age groups correspond closely to the actual percentages of existing units in Oklahoma City, Pittsburgh, and Milwaukee, indicating that age (at least for pre- and post-war construction) is not a factor in damage predictions. In Chicago and St. Louis, however, damage to units built in the last 25 years accounts for half the damage incidents, although the existing units of this age group comprise only one-quarter of the total units. This comparison indicates, as shown on the bottom of Table 30, that in these two boom areas, housing units less than 25 years old were damaged at a rate about three times greater than for units older than 25 years. As the percentage of newer units decreases, the ratio of incidents-to-units for newer than 25 years to older than 25 years increases, with Chicago and St. Louis exhibiting the most marked effect.

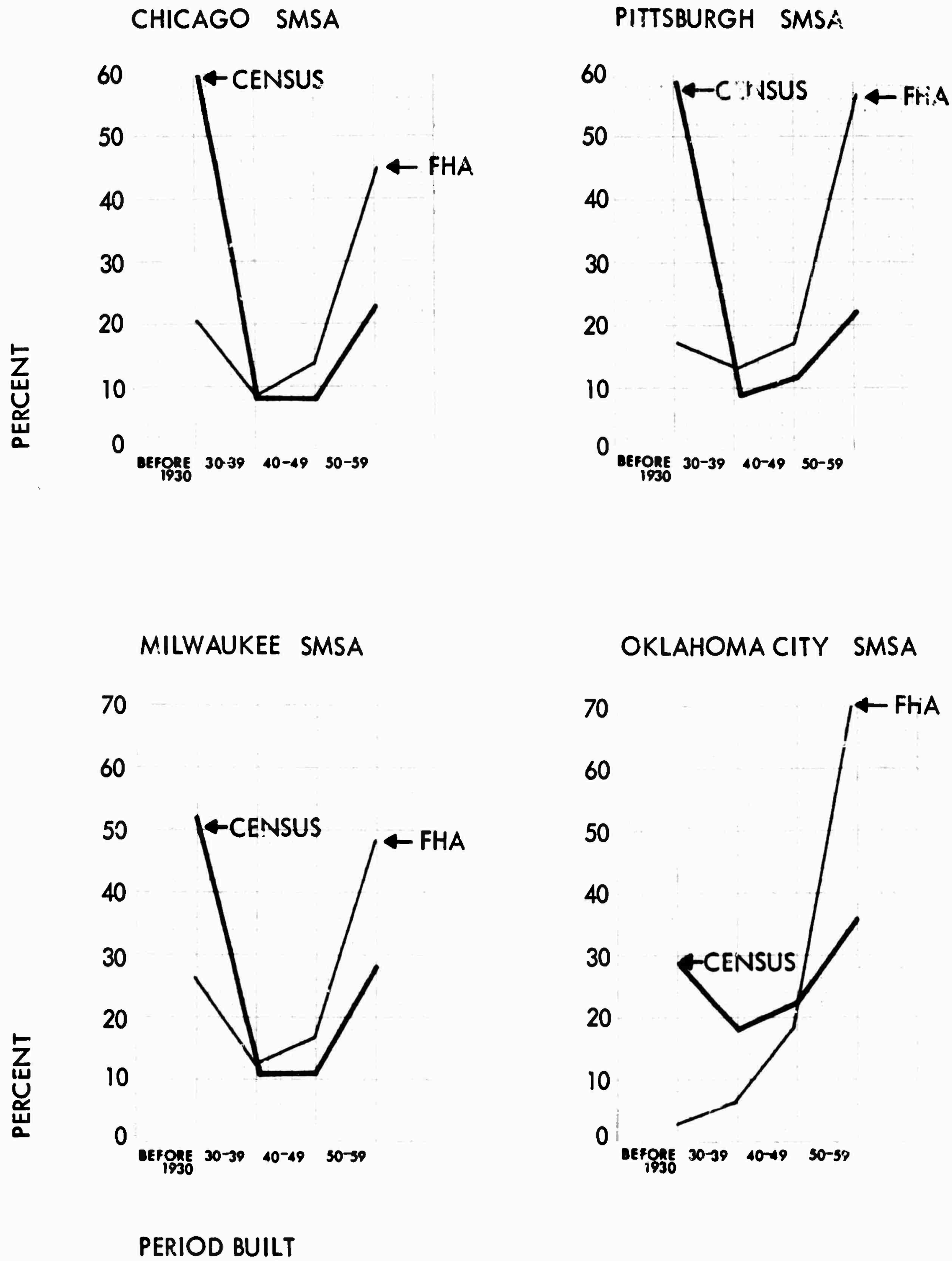
From the data analyses in Appendix F, it was concluded that single family dwellings older than 25 years are more easily damaged by sonic booms than newer dwellings. This conclusion is contrary to the conclusion drawn here--that if age were a factor, the dwellings constructed after 1940 appear to be more easily damaged. The fact that only single family units were compared previously--as compared to both single family and multifamily units here--is not believed to be the reason for the difference in conclusions. With such a high percentage of incidents occurring to the majority housing type (single family), adding the small percentage of multifamily units should not change the conclusions significantly.

The difference rests in the source from which the data base was obtained. Data base information for the interim report was taken from FHA Division of Research and Statistics 1964, while the U.S. Census of Housing-1960 was used for this report. Figure 11 compares the data base information obtained from these two sources.

As can be seen, the FHA data are skewed toward more recent periods and are not consistent with the total data base as determined by the U.S. Census of Housing. This difference may be due to (1) the types of houses that FHA insures, (2) the fact that FHA data are for the entire SMSA, while the census data subsequently used relate precisely to the Greater City area, or (3) the relatively small sample of total houses that FHA data represent. Whatever the reason, this skewing of FHA data to the later periods accounts for the different conclusions. Because of the greater reliability of the housing census data in representing the age profiles of the total of existing structures, it is believed the conclusion drawn here is the valid one--that newer houses are affected to an equal, or greater, extent than older houses.

Figure 11

COMPARISON OF FHA AND US HOUSING CENSUS DATA



Only single family incidents and structures were used in comparing the owner and lessee occupied incidents to the data base. Multifamily structures are mostly lessee occupied, and it thus was believed that such a comparison would be of little value in testing the relative damage claim potential from high or low "owner" based cities for predictability purposes. Owner-lessee information was not available concerning commercial structures.

Table 31 shows that the paid damage incidents in owner occupied single family structures constitute a larger percentage of the total incidents in all boom areas than the corresponding percentage of existing structures that are owner occupied. Conversely, the paid claims rate of lessee occupied incidents per existing lessee occupied structures is lower than for single family structures. Thus, sonic boom damages are being claimed and paid for owner occupied houses at a rate of about two to four times (11 times in St. Louis) that for lessee occupied houses.

Table 31
TYPE OF OCCUPANCY* (DATA BASE)

	OBA	CBA	PBA	MBA	SBA	Total
Owner occupied						
Damage incidents	91%	93%	84%	85%	96%	90%
Existing structures	74	76	76	75	69	75
Lessee occupied						
Damage incidents	9	7	16	15	4	10
Existing structures	26	24	24	25	31	25
Taking the ratio of lessee incidents to lessee structures as unity, the ratio of owner-to-lessee paid damage incidence rates would be	3.5:1.0	4.2:1.0	1.7:1.0	1.9:1.0	10.7:1.0	3.0:1.0

* Single family only.

Since sonic boom damage is not sensitive as to structure occupancy, the explanation must be in the differences in attitude between the two types of occupants. The owner is normally more sensitive to the condition of his house than lessees are, since the owner pays for general upkeep and would be more observant to possible damage from sonic boom. The lessee, on the other hand, may react only to the most obvious damage, may be home less, or may seldom see the owner who is generally the one that must file the actual claim.

Interim Technical Report 2, in comparing damage incidents and existing single family structures in regard to building characteristics, used FHA Homes-1964 as its data source. In the discussion of the effect on age of structures, it was shown that FHA data--at least in regard to age--appear to be skewed toward more recent periods and thus are not representative of the total data base. Since no other applicable source was available on building characteristics, this comparison is not included here. Also, any use of the comparisons shown in Appendix F should carefully consider the possible prejudice toward more recent building construction characteristics.

VIII SPECIAL ANALYSES

VIII SPECIAL ANALYSES

Comparison of Estimated Repair Costs and Payments

To this point, many aspects of the claims for sonic boom damage have been discussed: a general appraisal has been made of total claims, the paid and denied claims have been compared, and paid claims believed to best represent those of probable-to-possible sonic boom causation have been studied in detail. Where possible, comparisons of the paid claims to the data base were made. But so far nothing has been said concerning the costs of repair and the payments made in regard to these costs.

Cost is one of the more important items in understanding the magnitude of the sonic boom damage problem, both past and future, and in predicting damage costs to be incurred in the future as a result of supersonic transports or other supersonic aircraft.

Table 32 provides information on estimated repair costs for glass, plaster, and other damage and also the payments actually made for these types of damage. Information in the data bank regarding damage repair costs is expressed in terms of "incidents," whereas the data from the Air Force Weekly Reports on payments were in terms of "claims." To make the two comparable, they were converted to an approximate cost per claim by multiplying the average damage cost per incident by the number of incidents per claim for each boom area.

The amount paid generally does not equal the estimated damage cost because of Air Force policy that damage repairs should not improve the value of an installation or otherwise enrich existent damaged property.

The average damage repair cost per claim for glass damage is variable, ranging from $52 per claim in Oklahoma City to $120 per claim in St. Louis. However, even though the repair costs are variable, the percentage of these estimated amounts paid is nearly 100 percent in all areas except St. Louis, which is 84 percent.

The average damage repair costs per plaster claim is fairly consistent at about $165 for the controlled overflight areas; however, it is about twice this amount for FY66 claims. (Since the average damage cost for FY66 claims is also higher for glass and other damage, this could be due

Table 32

DAMAGE COST VERSUS PAYMENT BY TYPE OF DAMAGE

(Paid Claims, Including Paid Appeals)

	OBA	CBA	PBA	MBA	SBA	Average	FY66
(Average Incidents per Claim)	(1.06)	(1.04)	(1.05)	(1.05)	(1.08)	(1.05)	(1 12)
(a) Glass damage							
Average damage cost/incident, estimated*	$ 49	$ 82	$ 60	$ 51	$111	$ 75	$ 98
Average damage cost/claim, estimated†	52	85	63	54	120	79	110
Average amount paid/claim‡	--	80	61	50	101	--	109
Percent paid of estimated amount	--	94%	97%	93%	84%	--	99%
(b) Plaster damage							
Average damage cost/incident, estimated	$154	$155	$145	$173	$160	$157	$292
Average damage cost/claim, estimated	163	161	152	182	173	165	327
Average amount paid per claim	--	102	55	60	57	--	123
Percent paid of estimated amount	--	64%	36%	33%	33%	--	38%

(continued)

Table 32 (concluded)

	OBA	CBA	PBA	MBA	SBA	Average	FY66
(c) "Other" damage							
Average damage cost/incident, estimated	$ 48	$ 49	$ 52	$ 36	$ 70	$ 50	120§
Average damage cost/claim, estimated	51	51	55	38	76	52	135§
Average amount paid per claim	--	32	47	35	56	--	93§
Percent paid of estimated amount	--	63%	85%	92%	74%	--	69%
(d) Total damages							
Average damage cost/incident, estimated	$ 95	$ 89	$ 69	$ 87	$127	$ 89	$128§
Average damage cost/claim, estimated	101	93	72	91	137	93	143§
Average amount paid per claim	61	80	64	50	76	72	103§
Percent paid of estimated amount	70%	86%	89%	55%	55%	78%	72%

* Cost data taken from two estimates or, where available, a paid invoice contained in claims file.

† For groups a, b, and c, cost/claim is only indicative of relative values, since by definition, a claim can contain more than one type of damage. Cost/incident and all of group d figures are finite, however, as they are independent of this limitation.

‡ Payment information obtained from USAF Weekly Reports for five boom areas and from claims files for FY 66 incidents. Information on Oklahoma City available for total damage only.

§ Does not include incidents of $10,909, of which less than five percent was paid, and $5,300 and $4,782, both involving mink.

to a general increase in repair costs with time or for different regions of the country.) Except for the Chicago boom area, only about a third of the amount claimed was paid.* Again, this low percentage is due to the policy that payment for damage should be limited to replacement in kind with no improvement of the property. Since most plaster damage paid was for aggravation of existing damage or impending damage, usually only a portion of the claimed amount was paid.

Average damage repair or replacement cost for "other" damages for the controlled overflight areas is approximately $50 per claim, with FY66 again having a considerably higher cost. The amount actually paid varied from 63 to 92 percent of the amount claimed.

The composite of all types of damage results in an average damage repair cost per claim of $93 for the controlled overflight areas and $143 for FY66. The average amount paid was $72 for the five boom areas and $103 for FY66, or about 75 percent of repair estimates for all areas. This ranged from 55 percent in St. Louis and Milwaukee to 89 percent in Pittsburgh, with Oklahoma City in the midrange at 70 percent.

Appeals

Air Force claims procedures, in effect, allow the claim file of a claimant dissatisfied with a decision to be forwarded to Headquarters, United States Air Force (AFJALD), for review, opinion, and action. This section analyzes the quantitative effect of this procedure on total claims handling and total payments made. A profile of the typical appellant is also indicated.

Information on the five boom areas in Tables 33 and 34 was prepared from data in the final report Special Claims Offices: Sonic Boom Report Analysis for the Period Ending 31 October 1666, and information for FY66 was prepared from claims information in the data bank through December 1966.

Of the 11,611 adjudicated claims from all the indicated sonic boom events, approximately 10 percent were appealed. Although additional investigations in the field were not required, appeals doubled, if not

* As the amount claimed was generally always the same as the amount established by bonafide contractor estimates, the "claimed amount" was taken as equal to the "Damage Cost, Estimated."

trebled, the office handling time for this 10 percent of the files.* The rate at which appeals were filed varied from 7 percent of total claims filed in the "B-58 cities" (weighted average) to 15.5 percent in the Oklahoma City boom area. This appeal rate in Oklahoma City, approximately twice as great, was no doubt due to the lesser payment-to-claims ratio there (see Table 1). From Table 34 the more comparable ratios (in percent) of appeals-to-denied claims suggests that a claimant dissatisfied with the disposition of his claim at the field level was only slightly more apt to appeal his case if he lived in Oklahoma City than in Chicago, Pittsburgh, or Milwaukee. As suggested, the percentage difference was due to differences in payment rates.

Table 33
APPEALS--SUMMARY

	OBA	CBA	PBA	MBA	SBA	FY66	Total
Claims adjudicated	4,901	3,116	1,088	621	476	1,409	11,611
Claims appealed	769	237	81	36	22	64*	1,209
Percent of adjudications	15.5	7.5	7.5	6	4.5	4.5	10.5
Average amount appealed	$485†	‡	$315§	$265**	$245	$420††	--

* Includes four appeals involving animals.
† Based on 69 appeals (9 percent sample).
‡ Available data not representative as to amounts appealed.
§ Does not include appeals for $17,900, $19,350, $5,220.
** Does not include appeal for $3,600.
†† Does not include two appeals for $3,900 each.

Table 34
APPEALS--DENIED CLAIMS

	OBA	CBA	PBA	MBA	SBA	FY66	Total
Claims denied	4,612	1,652	585	262	261	688	8,060
Appeals as a percent of denied	16.5	14.5	14	14	8.5	9.5	15

* All appeals must be forwarded to the Staff Judge Advocate, Air Force Logistics Command, before they are sent to Headquarters (AFJALD).

The data bank contains 289 appeal cases, comprising essentially all appeals in Pittsburgh, Milwaukee, St. Louis, and FY66; 9 percent of the appeals in Oklahoma City, including all cases where amounts were paid due to appeal; and paid appeal files for the Chicago boom area.

Table 35 shows that only 3 percent of the findings of the base claims officer were reversed or amended. Although the average payment made under benefit of appeal ($75) is comparable to payments made by direct award at the field level, the effect on total amounts paid for appealed damages is negligible in the B-58 cities. The 6 percent of total payments indicated for the Oklahoma City boom area could be due to both the larger percentage of appeals in Oklahoma City and policy differences between the field and Headquarters levels. In any event, it seems evident that the cost of handling appeals far outweighs the cost of the awards made.

Table 35
APPEALS--PAID AND DENIED

	OBA	CBA	PBA	MBA	SBA	FY66	Total
Appeals denied (prior total denial of claim at base level)	741*	214†	72	26	21	55	1,129
Appeals denied (prior partial denial of claim at base level)	6	10	7	3	2	7	35
Appeals paid in full or in part	21	10	3	1	1	2	38
Percent of total appeals	2.7%	4.2%	3.7%	2.8%	4.5%	3.1%	3%
Amount awarded under appeal	$1,172	$1,206	$361	$22	$7	$116	$2,884
Percent of total moneys paid	6	1	1	0+	0+		
Average amount awarded	$ 56	$ 120	$120	$22	$7	$ 58	$ 75

* From USAF records; sample only in data bank.
† From USAF records; none in data bank.

Table 36 indicates various characteristics of the 289 appeal cases reviewed.

Table 36
APPEALS--CHARACTERISTICS

	OBA*	CBA†	PBA	MBA	SBA	FY66
Central city location	94%		47%	50%	58%	n.a.
Suburban location	6		53	50	42	n.a.
Owner occupied	90		93	86	96	80
Single family residence	90		83	80	92	87
Multifamily structure	6		9	7	8	1
Commercial structure	4		8	13	0	12
Older than 25 years	65		55	36	35	46
Wood frame	90		58	71	70	80
Masonry frame	10		42	29	30	20
One or two stories	100		86	97	90	96
Appealed miscellaneous damage incidents	29		42	47	52	37
Appealed plaster damage incidents	56		30	42	44	41
Appealed glass damage incidents	15		24	8	4	18
Appealed fallen object incidents	0		4	3	0	4
Engineer investigated	84		50	77	54	67

* Percentages based on 9 percent sample of the 769 appeals filed.
† Chicago percentages not comparable; only appeal files where some award was made are included in the data bank and therefore are considered unrepresentative of general characteristics.

Where cities have incurred suburban sprawl, there is an equal chance of the appellant living in either the central city or a suburb. Nine times out of ten, he will be owner of a single family residence.

The highest incidence of appeals involves miscellaneous damages that are not normally considered susceptible to damage by sonic boom--hot water heaters, bathroom fixtures, concrete foundations, TV sets, and chimneys. An exception is in the Oklahoma City boom area, where almost twice as many plaster incidents were appealed as were miscellaneous damages, no doubt due to the comparatively high rate of plaster damage claimed there over other types (65 percent plaster and only 8 percent glass). Appealed damage types generally followed in reverse order the statistical likelihood of payment for the various types (see Table 18).

Startle Effect on People and Animals

Although the data retrieval and analyses mainly considered the nature and extent of damage to structures, two additional causes of public reaction to sonic booms were considered--injury, real or imagined, to people and animals. For purposes of this report, poultry and egg production are included in the animal category.

Of the 5,572 claims in the data bank, nine involve startle, or at least presumed startle, of people and 25 of animals. (These 34 cases are described briefly in Appendix C.) Since the data bank does not include the unpaid claims in Chicago or most of the unpaid claims in Oklahoma City, an approximation was made for the purposes of establishing startle incidence as a function of total claims (Table 37). Assuming the incidence of startle cases is the same for "nonincluded unpaid claims" as for "included unpaid claims," there was less than one personal injury claimed per 1,000 claims in the five boom areas as compared with 3.5 per 1,000 on nationwide FY66 basis. Of the approximately 12 cases, only two were paid.

The incidence of claims involving animals is almost twice that for people in the boom cities and almost four times that for people in FY66. Considering the population of domesticated animals to be far less than that of people, at least in the numerous urban areas overflown, it can be surmised either that animals are much more sensitive to sonic booms than humans, or that claims involving animals merely manifest unfavorable human reactions to sonic boom disturbances. Although the overall number of people and animal claims is very small (approximately 0.4 percent of all claims), 36 percent of the animal cases were paid, compared with 16 percent of the cases involving people.

A 13 September 1966 report by R. L. Atwood to the Committee on SST-Sonic Boom provides some additional insight into claims involving animals. This report, summarized in Table 38, indicates that of 29,824 sonic boom claims filed during FY62 through FY66, 163 were concerned with animals.

Table 37
CLAIMS INVOLVING STARTLE

	Five Boom Areas	Fiscal Year 1966	Total
People			
Claims in data bank	4,163*	1,409	5,572
Startle cases in data bank	4 (2 paid)	5 (none paid)	9
CBA and OBA claims not in data bank	6,000±	--	6,000±
Estimated unpaid cases not in bank	3	--	3
Estimated totals:			
claims	10,000	1,400	11,400
cases	7	5	12
rate (per 1,000 claims)	0.7	3.5	1
Animals			
Startle cases in data bank	7 (3 paid)	18 (8 paid)	25
Estimated unpaid cases not in bank	6	--	6
Estimated totals:			
claims	10,000	1,400	11,400
cases	13	18	31
rate (per 1,000 claims)	1.3	13	2.7

* Includes 16 claims from Edwards AFB tests in June 1966.

Table 38

STARTLE EFFECT - ANIMAL CLAIMS, FISCAL YEARS 1962 THROUGH 1966

(29,824 Claims)

Classification	Cases	Paid	% Paid	Average Amount Paid	Ranking by "% Paid" (weighted)	Open Cases (amount claimed)
Chickens	33	16	49%	$ 200	1	3 ($6550)
Horses	25	10	40	397	2	3 ($15,278)
Cattle	18	10	55	276	3	1 ($476)
Eggs	16	1	6	3	6	
Dogs	16	1	6	48	6	
Mink	13	9	6[illegible]	1,700	4	4 ($139,419)
Turkeys	11	4	36	4,650*	5	
Pheasants	2	1	50	17	6	
Rabbits	2	1	50	350	6	2 ($310)
Hogs	1	1	100	87	6	
Cats	0	0	0	0	-	
Other	11	4	36	95	-	2 ($650)
Total	148	58	39%	$ 775†	-	15
Total cases						163
Rate (per 1,000 claims)						5.5 cases

* Includes one payment for $13,879.

† If $13,879 not included, average payment for other 57 claims would be $540.

Source: R.L. Atwood; Air Force Claims Data Management System; Report of 13 September 1966.

This results in a rate of 5.5 cases per 1000 claims, which falls between data bank figures for the five boom areas and FY66 and no doubt reflects the averaging effect of flights over both highly urbanized places and rural areas. The payment of 39 percent of the claims is consistent with the 36 percent noted above.

Of some significance is the $775 average payment made. Information in the Atwood report indicates that the average payment for damage to structures was considerably lower at $102 per paid claim. Although chickens accounted for the greatest number of claims, as well as the highest payment ratio (weighted), turkeys and mink were considerably more costly from the standpoint of claims payments.

Edwards AFB Overflights - June 1966

Edwards AFB complaint and claim files were analyzed to make preliminary comparisons with other claims data already in the data bank. Since sonic booms occurred from aircraft other than those scheduled in the June 1966 exercise, comparisons are only illustrative and do not lend themselves to analyses of rates for prediction purposes. All files, complaint logs, complaint documents, investigator reports, and flight logs were reviewed; the results are based on data retrieved through October 1966.

Between 3 June and 23 June, 165 scheduled sonic booms were logged on 15 boom activity days, yielding an average of 11 booms per day (OBA, 7.5 percent; CBA, 1.3; PBA, 1.3; MBA, 1.5; and SBA, 1.1). Approximately 60 percent of the logged sonic booms were occasioned by B-58s and 35 percent by Century Series fighters. Eight booms were by B-70, B-71, and YF-12 aircraft.

From this test series, 49 complaints of damage were received by the Air Force Claims Office, almost all of which were subject to investigation at the site of the damage. Sixteen claims had been filed and, after adjudication, 15 were approved either in whole or in part. This suggests that the claim-to-complaint ratio is 33 percent (OBA, 50 percent; CBA 44; PBA, 60; MBA, 67; and SBA, 35) and that the payment-to-claim ratio is 94 percent (OBA, 6 percent; CBA, 47; PBA, 46; MBA, 42; and SBA, 45). However, careful review of the investigators' reports suggests that another 15 reported damage occurrences were probably due to sonic booms, and full or partial payment would be recommended if claims are actually filed. Assuming that these 15 are valid incidents of damage (a total then of 30), the claims-to-complaints ratio would be 61 percent. The 94 percent payment-to-claims ratio may be reduced slightly; although, for purposes of comparisons, it has been retained. One reason for this potentially high

ratio might be that the explanation the investigator gave the claimant at the time of the investigation caused impossible or improbable complaints to not be filed as formal claims. Further, some of the booms generated during the Edwards tests were considerably more intense (on the order of 2 to 3 pounds per square foot nominal overpressure) than the nominal overpressure in other test cities.

In addition to the 30 known incidents of probable sonic boom damage in the Edwards AFB area (EBA), eight other claims were received at the Edwards AFB Maintenance Office for damage on the base, but no formal claim procedure was instituted to handle them. Table 39 compares the Edwards boom area with other boom areas.

Table 39

COMPARISON OF PAID CLAIMS*

	EBA/1	OBA	CBA	PBA	MBA	SBA
Glass	77%	38%	75%	71%	47%	44%
Plaster	7	45	14	12	32	42
"Other" damage	16	17	11	17	21	14
Single family structures	77	82	60	73	85	76
Commercial structures	23	15	29	20	10	17
Commercial structures, glass damage only	100	82	93	90	96	86

* For EBA, percentages include 15 probable damage incidents not yet filed as claims.

Twenty-six of the 30 damage incidents occurred on known dates; the following number and types of aircraft were recorded in flight test logs as having flown on the days indicated:

46% occurred on 20 June;	12th boom activity day;	10 B-58 booms
15% occurred on 21 June;	13th boom activity day;	13 B-58 booms
11% occurred on 13 June;	8th boom activity day;	8 B-58 booms
		2 F-104 booms
		2 B-71 booms

8% occurred on 7 June; 5th boom activity day; 10 B-58 booms
3 F-106 booms

(Eighty percent of the damage incidents occurred on four days of predominantly B-58 activity, as logged. The peak period of incidence was not in the initial days of sonic booms, as it was in Chicago, Pittsburgh, Milwaukee, and Oklahoma City; even though for the Edwards test, there were at least eight booms on the third activity day, 15 on the fourth, 13 on the fifth, and 16 on the sixth.)

8% occurred on 23 June; 15th boom activity day; 7 B-58 booms
7 F-104 booms
2 YF-12 booms

4% occurred on 8 June; 6th boom activity day; 12 B-58 booms
3 F-106 booms
1 B-70 boom

4% occurred on 9 June; 7th boom activity day; 15 B-58 booms
3 F-106 booms
1 B-71 boom

4% occurred on 14 June; 9th boom activity day; 6 F-104 booms

(The remaining 20 percent occurred on four days where most of the logged overflights were by B-58s, however, with a higher percentage of other aircraft logged. All days of damage had at least seven booms from B-58s. No damage was reported on the first, second, third, tenth, and eleventh boom activity days, when F-104s and F-106s were the only known aircraft flying in the test program, except for one B-70 flight on the second day.)

As previously noted, an additional number of booms from unknown aircraft occurred in the area during the test period; accordingly, it would be inappropriate to correlate damage to aircraft. Of the damage, 37 percent occurred in Tehachapi, 33 percent in Lancaster, 10 percent in Quartz Hill, and 7 percent in Palmdale. The remaining damage consisted of one incident each in Barstow, Rosamond, Lake Isabella, and Edwards AFB.

Sixteen incidents of damage were known to occur in structures constructed within the last 10 years. Eight structures were older than 10 years but less than 25 years old. Of occurrences where age of structure was noted, none involved structures older than 25 years. This is not consistent with statistics for the five boom areas, where 39 to 65 percent of the damage occurred in older structures; however, this is readily explained by the vast percentage of newer homes in the Edwards area.

Housing census data for 1960 indicates that approximately 86 percent of all single family structures in the Lancaster-Palmdale area were constructed after 1950. This far exceeds the percentages shown in Table 20 for the other boom areas, even since 1940.

Claims data from the recent second series of Edwards AFB overflights are understood to be minimal. They are not included in the data bank at this time.

Appendix A

STRUCTURE DESIGNATORS, DAMAGE DESCRIPTORS, AND SAMPLE "SUPPLEMENTARY CLAIMS RECORD" FORM-REVISED

Command	Fiscal year	Claim number	Location (AFB)	Street number		Aircraft	No. of windows damaged or plaster surfaces damaged
1-3 CMD	4-5 FY	6-10 CLM NO	11 L	12-16 STR NO	17-30 STREET NAME	A	S
OCA	64	11990	Q	733	ROLL NS RD	2	4

	Floor where damage occurred		*	*	Type of occupant	Use of structure	Building characteristics		Condition of building	Height of building (by floors)	Repair cost (actual or contractor's estimate)
34-41 CITY	42-47 DATE	F	49-51 STATE	a	b	T	U	BC	58-61 AGE	CN	HT	66-69 RPR CO
OKL	21 364	1	OKL	2	5	L	S	WH	1940	SD	3	3

Command: OCA, MAA, LOG, HAF

Fiscal year: 64, 65, 66

Location (AFB): N, Q, D, C, (Blank)

No. of windows damaged or plaster surfaces damaged: 1, 2, ..., 99

Date: Day, Month, Year

Floor where damage occurred: 1, 2, ..., 9, 0 (= 10 +)

Type of occupant: O, L, M

Use of structure: S, M, C, I

Condition of building: SD, FR, DD

Height of building: 1, ..., 99

OCA (Blank) = Oklahoma City
MAA-N = Pittsburgh
OCA-Q = Milwaukee
LOG-C = Chicago
OCA-D = Chicago
HAF = Hdqtrs. Washington, D.C.
OCA-N = St Louis

MAA = Middletown Air Materiel Area
MOA = Mobile Air Materiel Area
OCA = Oklahoma City Air Materiel Area
OOA = Ogden Air Materiel Area
SAA = San Antonio Air Materiel Area
SMA = Sacramento Air Materiel Area
WRA = Warner Robins Air Materiel Area
WPB = Wright-Patterson Air Force Base

Blank = No known aircraft in area
1 = Century Series
2 = B-58
3 = B-70
4 = SR-71, YF12
5 = F-5
6 = F-4, RF4
7 = T-38
8 = F-8
9 = Unknown

O owned
L leased
M other

S single
M multiple
C commercial
I industrial

SD sound
FR fair
DD delapidated

W wood
WS siding
WH shingle
AS asbestos shingle
FB fiber board
BS brick or stone veneer
SC stucco or concrete block veneer
FF combination
OF other

M masonry
MB brick or stone
MC stucco or concrete block
MM combination
OM other
FM combination (W and M)
CC concrete (reinforced)
SL steel - light
SH steel - heavy

Figure A - 1

STRUCTURE DESIGNATORS, DAMAGE DESCRIPTIONS, AND SAMPLE SUPPLEMENTARY CLAIMS RECORD FORM (Revised)

* Sorting Code - see Table A - 1

A

Condition of building

Height of building (by floors)

Repair cost (actual or contractor's estimate)

Damage type (nature of)

Investigator

58-61 AGE	CN	HT	66-69 RPR COST	DAM	72-77 REMARKS	I	c	4
9 4 0	S D	1 3	1 3 2	5 6	L T W M P S	E		4

SD
FR
DD

sound
fair
delapidated

1
:
99

E = Engineer
A = Air Force (non-eng)
I = Insurance Co.
Φ = Other
U = Unknown
N = None

wood
iding
hingle
sbestos shingle
iber board
rick or stone veneer
tucco or
oncrete block veneer
ombination
ther

nasonry
rick or stone
tucco or concrete block
ombination
other
ombination (W and M)
oncrete (reinforced)
teel - light
teel - heavy

AGR aggravated glass
PRO progressive glass or plaster
LTH lath
BRD plaster board W-wet; D-dry
WDO window glass
PLT plate glass
CAR auto window

MIR mirror
MFD multiple floor damage
CDR claim denial recom'ed, yet pd.
ENG engineer
ACO acoustical tile
GRH greenhouse - no. damaged
EXS extra strength glass
THR thermal pane
FRM structural frame
CHM chimney
CON concrete
STC stucco
APL appliance
CIS cistern
FIX fixture (plumbing)
BRK brick
CER ceramic tile
SIL silo
WAL wall
FOU foundation
SLB slab floor, patio, sidewalk
PIP pipe
ROF roof

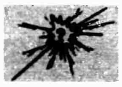
RTV radio - TV
LMP lamp
PER personal injury
DOG dog
HOR horse
CPR claim payment recommended, yet denied

75 76 GLASS DAMAGE ONLY

A Aluminum frame
S Steel "
M Metal " (exact metal unknown)
W Wood "
F Fixed "
H Hinged "
S Sliding "

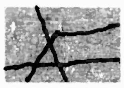
GLASS

1 Glass Breakage
Unknown nature



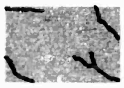
2 Minimum dimension less than 2 feet
3 " " 2 to 4 feet
4 " " 4 feet and greater

2 Glass Breakage
Horizontal, vertical, diagonal cracks from edge; radial from center



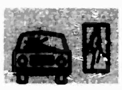
2
3 Same as above
4

3 Glass Breakage
Across corner



2
3 Same as above
4

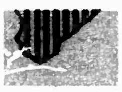
4 Glass Breakage - Misc.
Auto, mirror



0

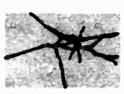
PLASTER

5 Plaster Damage - Fallen
Generally at central area but may extend to edge or corner



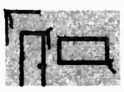
5 Aggravated damage
6 New damage
7 Unknown

6 Plaster Damage - Cracked
Horizontal, vertical, diagonal (but not from corners); may be "hair line" or "numerous"



5
6 Same as above
7

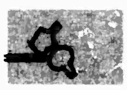
7 Plaster Damage - Cracked
Radiating from corners or along angle joints or seams



5
6 Same as above
7

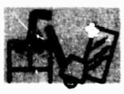
OTHERS

8 Fallen Object
Bric-a-brac



8 Loose

8 Fallen Object
Fixtures, lamps, mirrors, stove pipes, etc.



9 Secured

9 Miscellaneous
TV, bathroom and floor fixtures, animals, people, structures, etc.

0

B

Table A-1

SORTING CODES--SUPPLEMENTARY CLAIMS RECORD FORM

Sorting Code "a", Key Punch Card Field #52:

1 = Glass
2 = Plaster
3 = Fallen object
4 = Miscellaneous

Sorting Code "b", Key Punch Card Field #53:

1 = Oklahoma City boom area
2 = Chicago boom area
3 = Pittsburgh boom area
4 = Milwaukee boom area
5 = St. Louis boom area (second)
6 = Edwards AFB experiment (first)
7 = Fiscal Year 1966

Sorting Code "c", Key Punch Card Field #79:

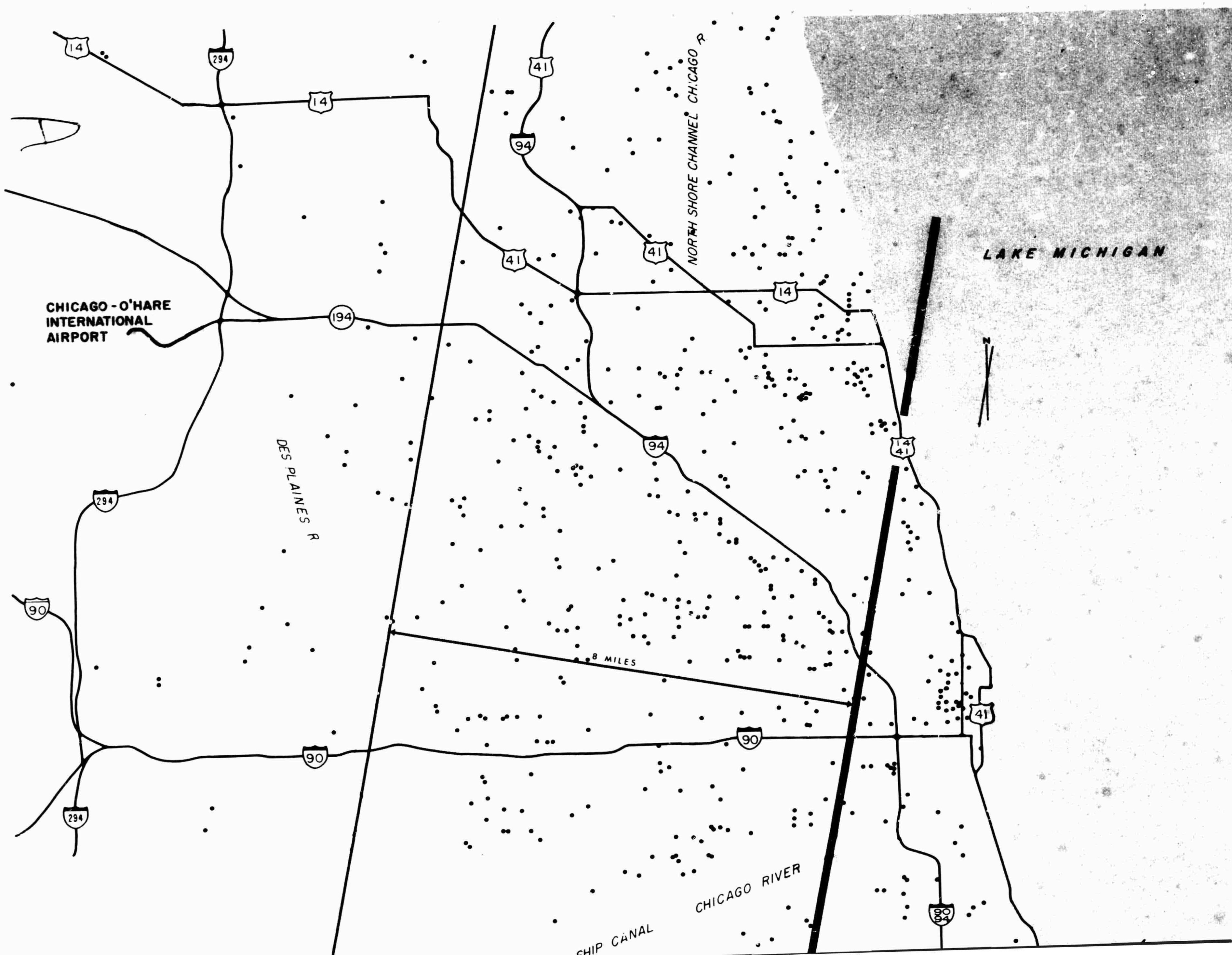
Z = 2 or more incidents of damage

Sorting Code "d", Key Punch Card Field #80:

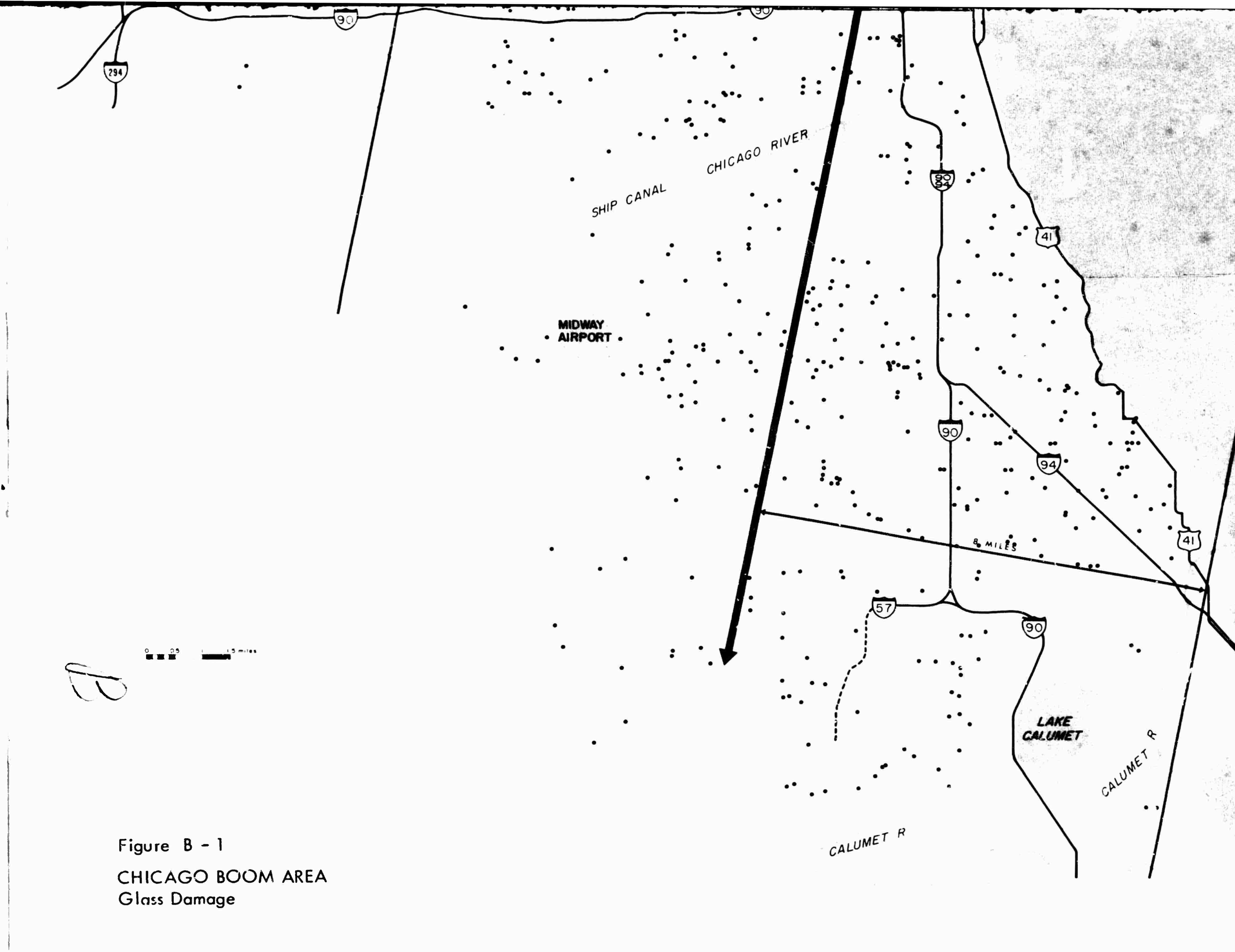
0 = Investigation only
1 = Claim filed; claim paid in full
2 = Claim filed; claim paid in part
3 = Claim filed; claim denied
4 = Claim filed; partial payment offered, appealed, full payment made
5 = Claim filed; partial payment offered, appealed, award increased
6 = Claim filed; partial payment offered, appealed, appeal denied
7 = Claim filed; claim denied, appealed, full payment made
8 = Claim filed; claim denied, appealed, partial payment made
9 = Claim filed; claim denied, appealed, appeal denied

Appendix B

DAMAGE LOCATION MAPS



LAKE MICHIGAN
N
NORTH SHORE CHANNEL CHICAGO R
CHICAGO - O'HARE
INTERNATIONAL
AIRPORT
DES PLAINES R
8 MILES
CHICAGO RIVER
SHIP CANAL
14
294
41
94
194
90



B

Figure B - 1

CHICAGO BOOM AREA
Glass Damage


LAKE MICHIGAN
NORTH SHORE CHANNEL CHICAGO R
CHICAGO - O'HARE
INTERNATIONAL
AIRPORT
DES PLAINES R
8 MILES
CHICAGO RIVER
SHIP CANAL
14
41
94
194
294
90

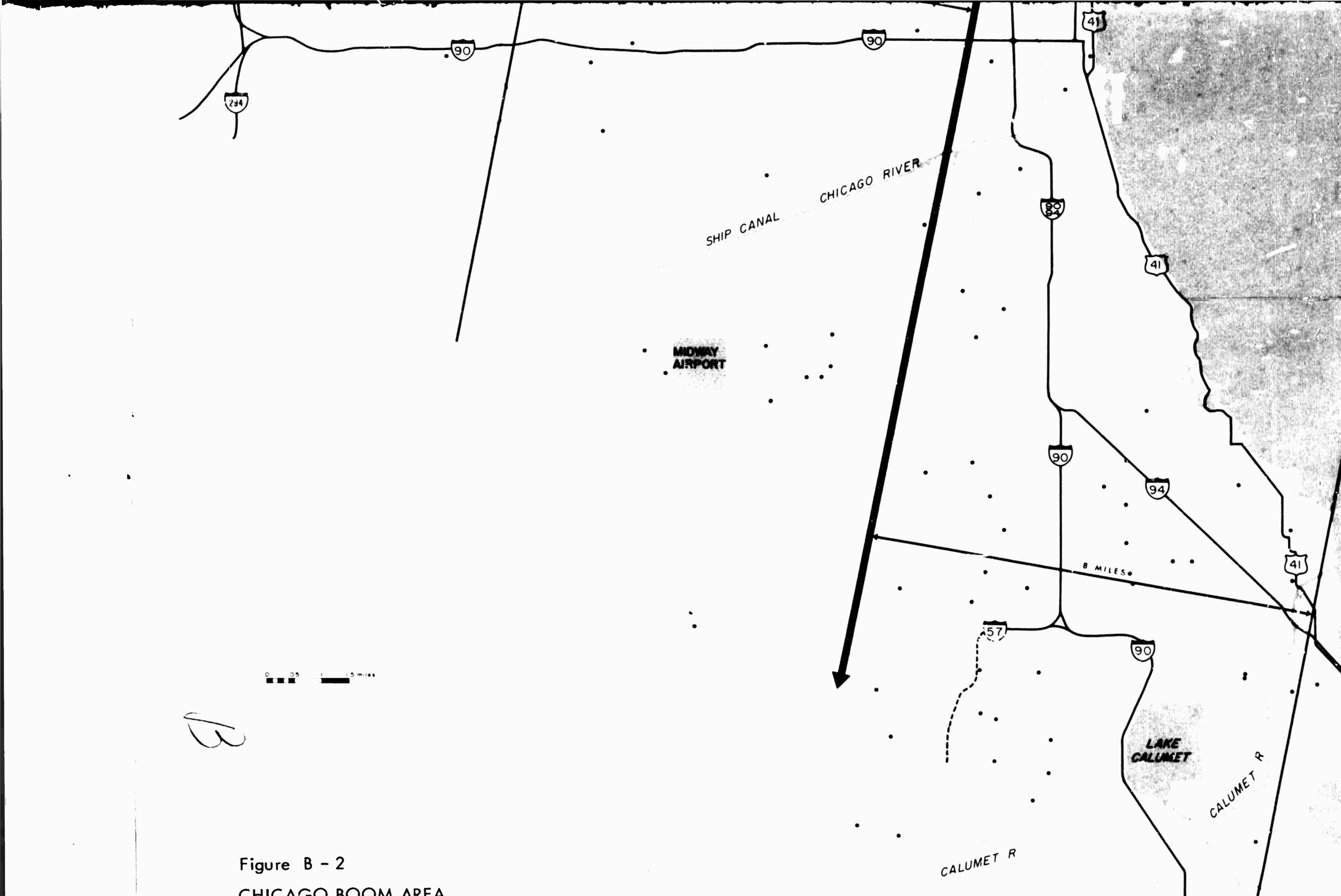


Figure B - 2

CHICAGO BOOM AREA
Plaster Damage

CHICAGO - O'HARE INTERNATIONAL AIRPORT
LAKE MICHIGAN
NORTH SHORE CHANNEL CHICAGO R
DES PLAINES R
CHICAGO RIVER
SHIP CANAL
8 MILES
N
14
294
41
94
194
90
14 41

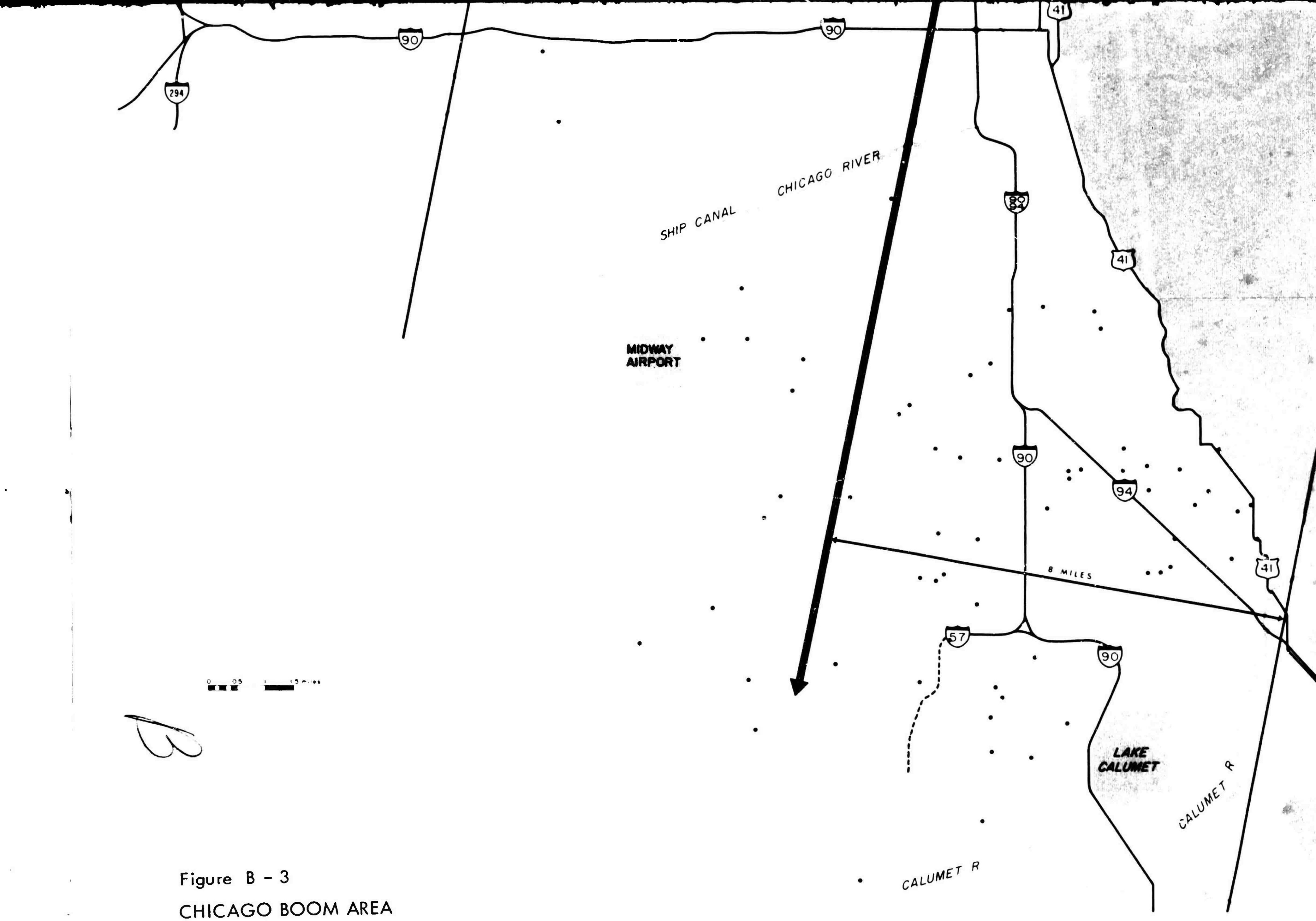
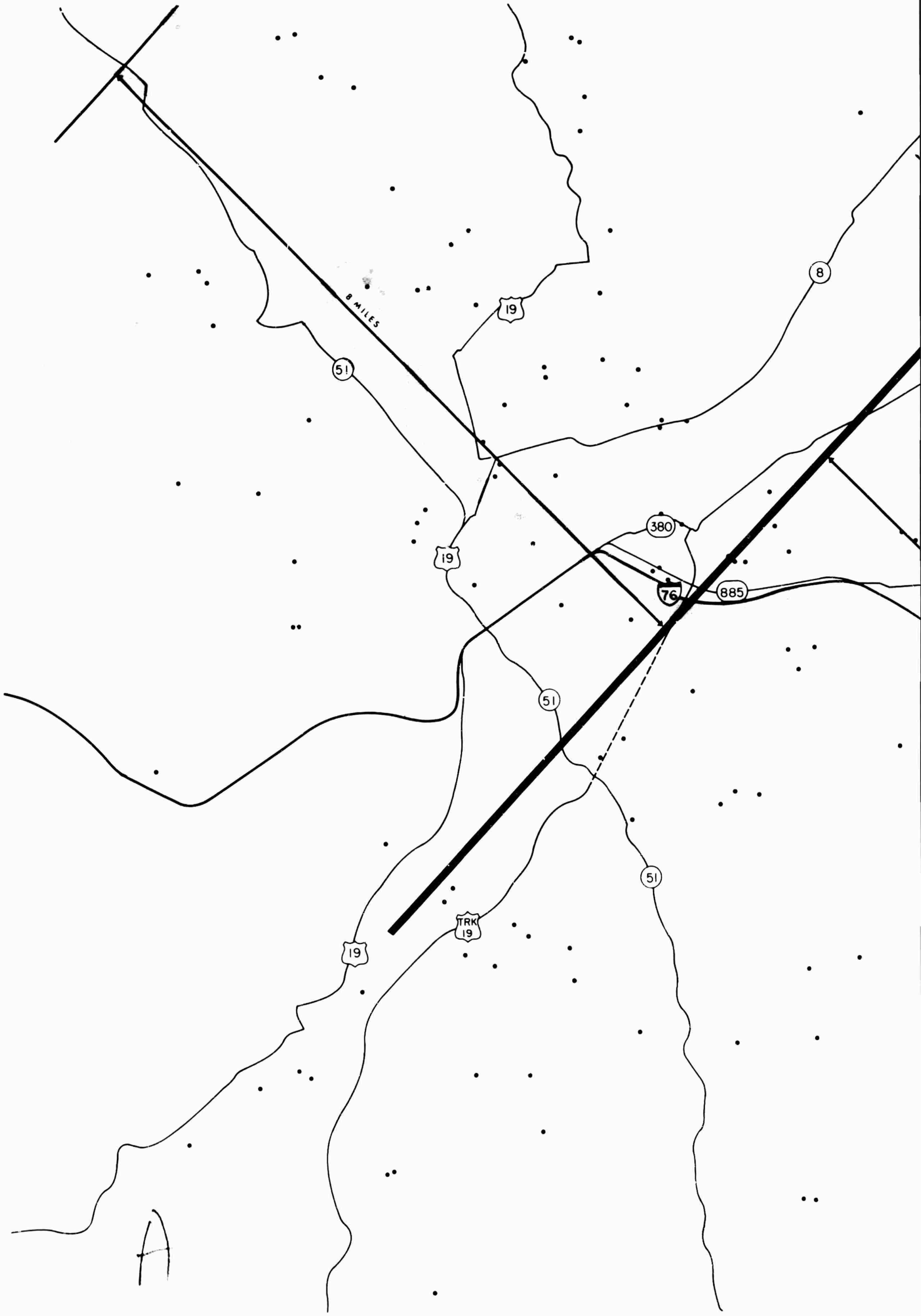


Figure B - 3

CHICAGO BOOM AREA
Other Damage



8 MILES
19
51
8
380
76
885
19
51
51
TRK 19
19
A

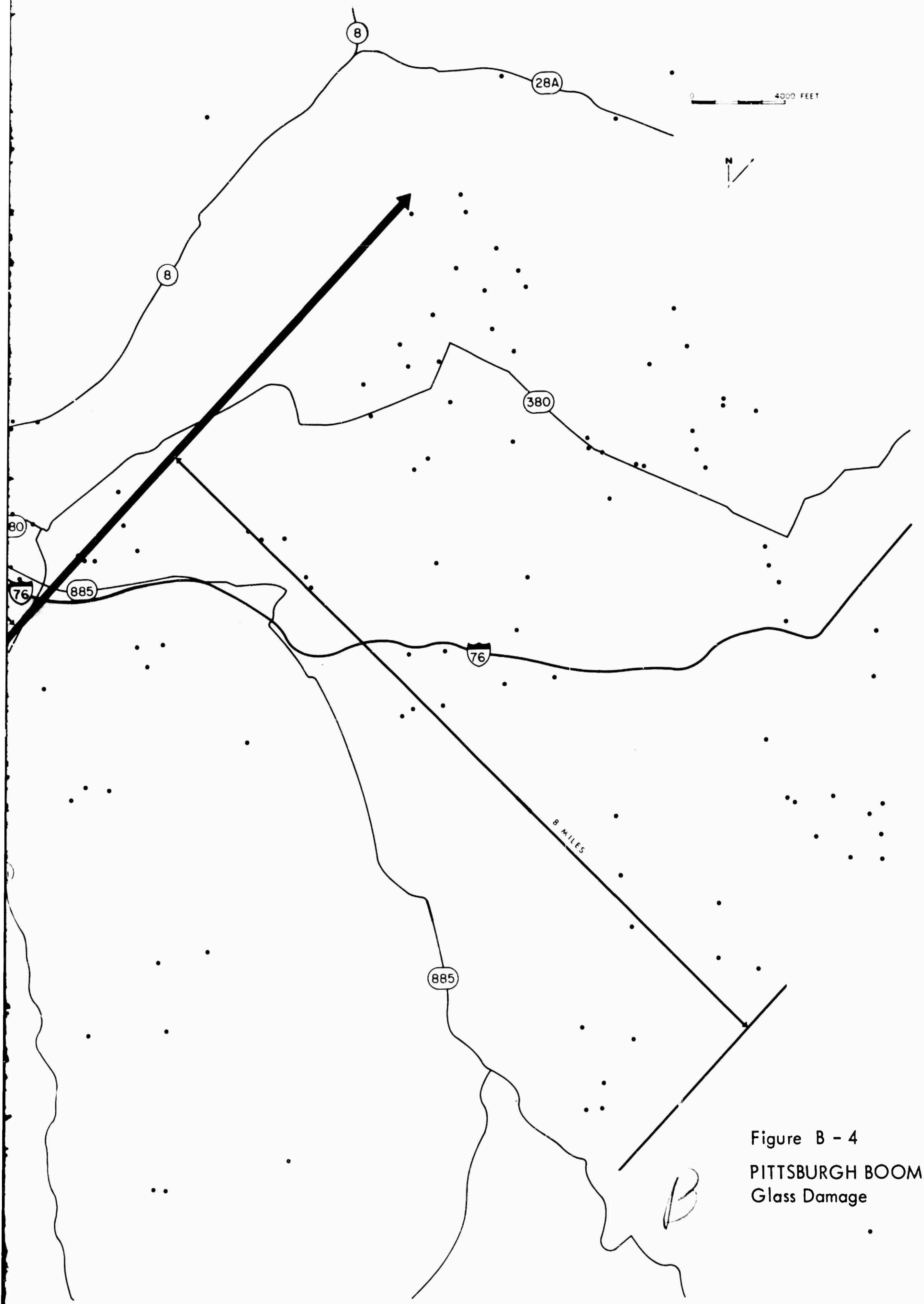


Figure B - 4

PITTSBURGH BOOM AREA
Glass Damage


8 MILES
19
51
8
380
76
885
19
51
51
TRK 19
19
A

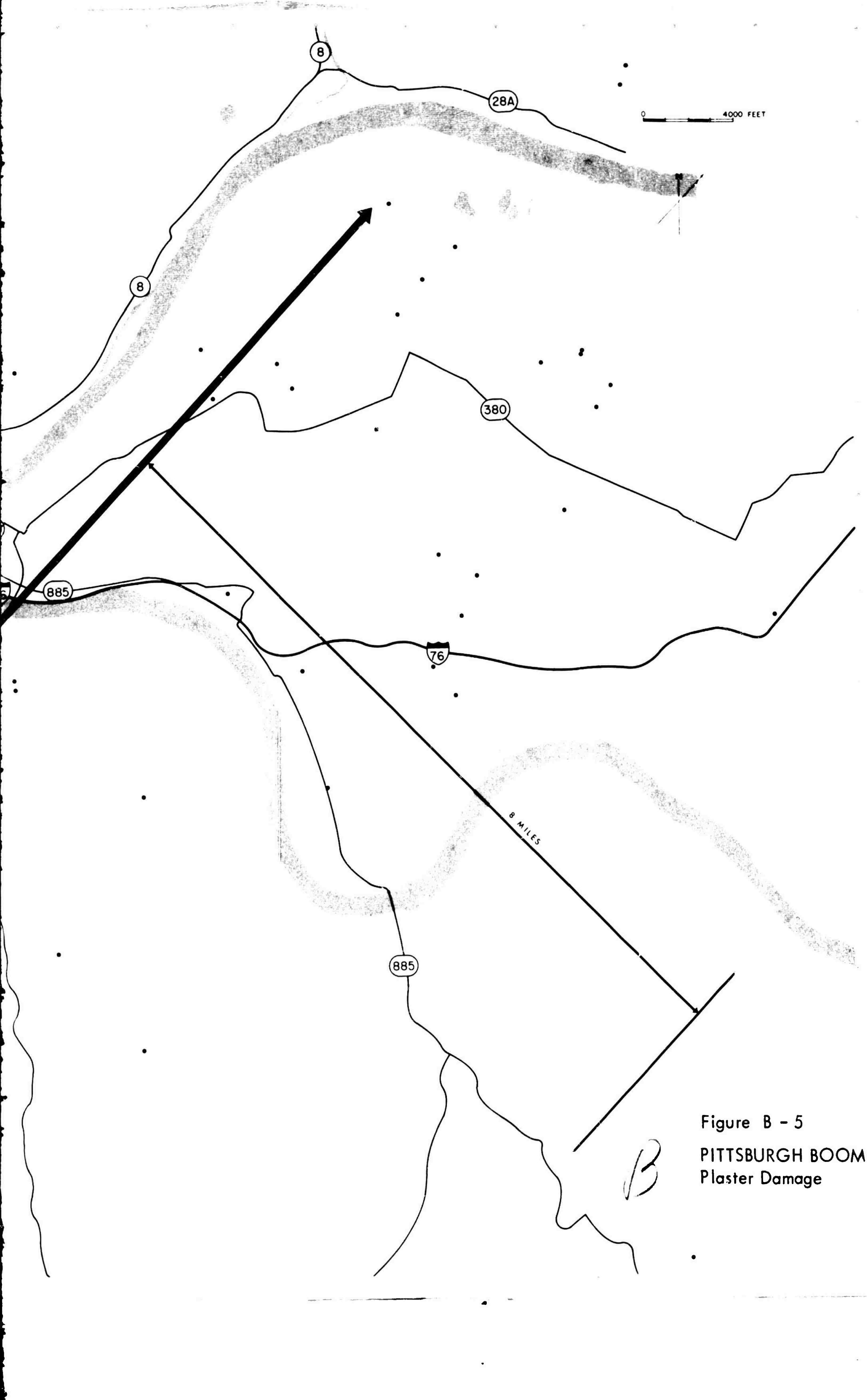
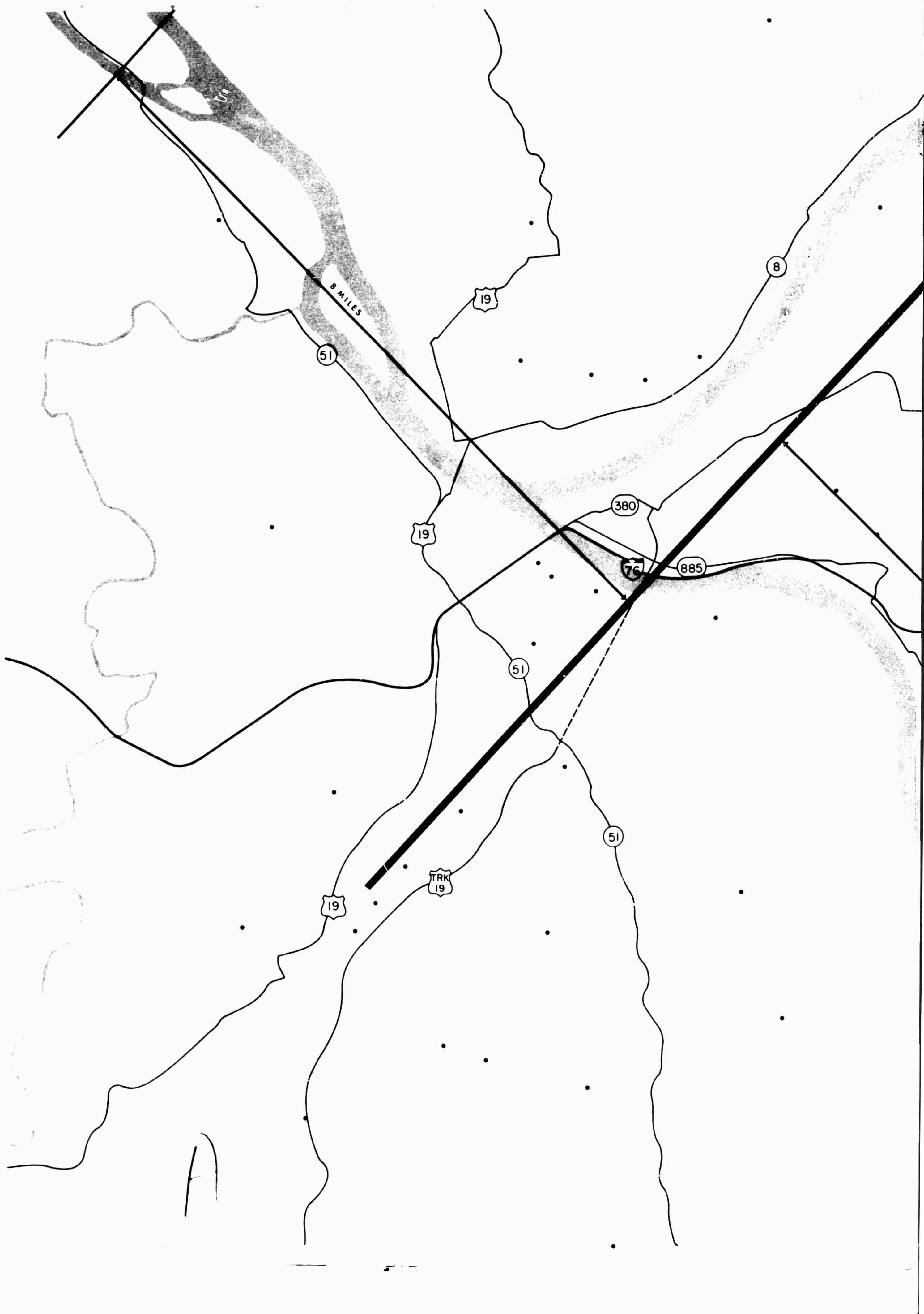


Figure B - 5

PITTSBURGH BOOM AREA
Plaster Damage



8 MILES
8
19
51
380
76
885
TRK 19
A

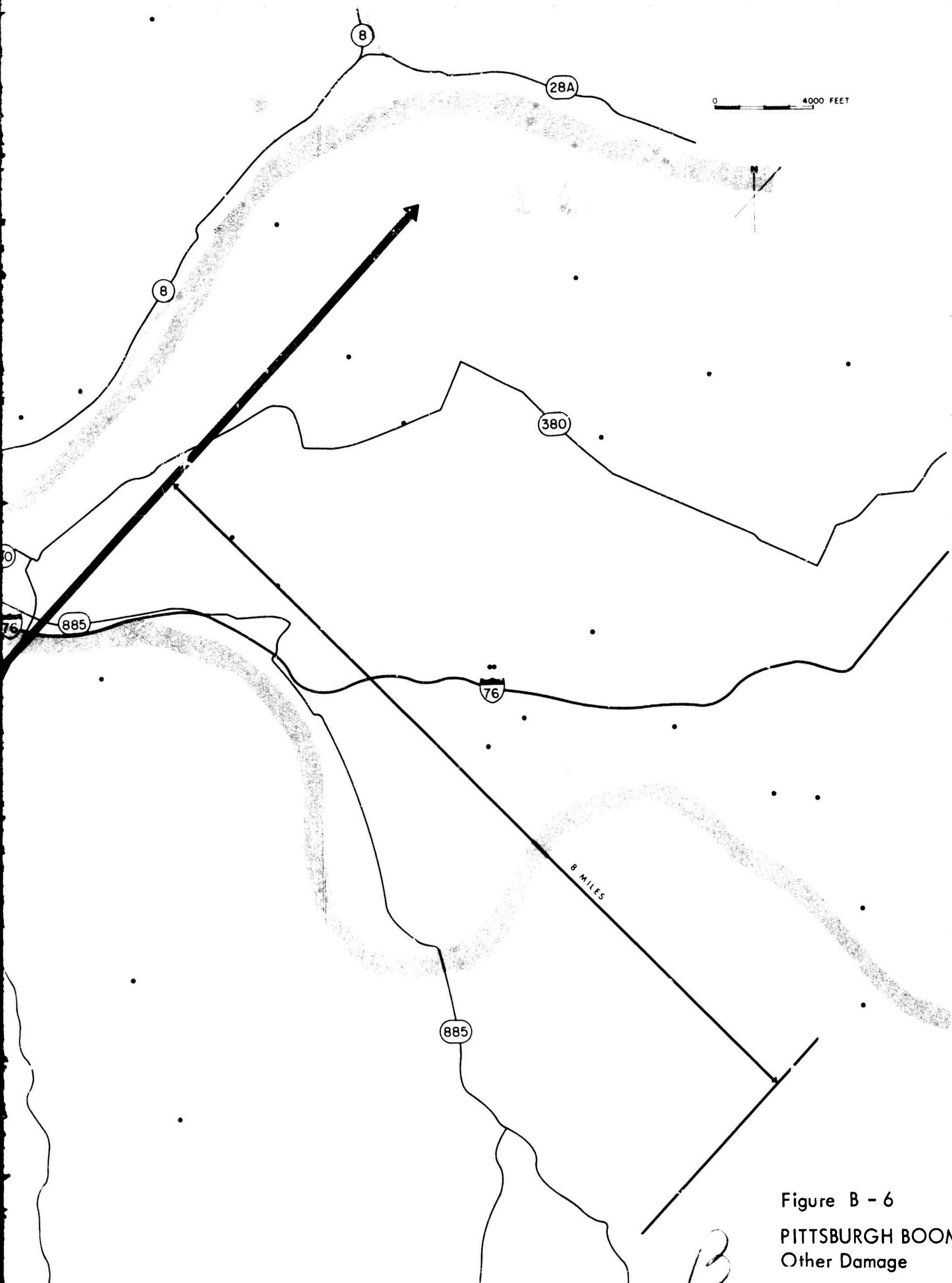
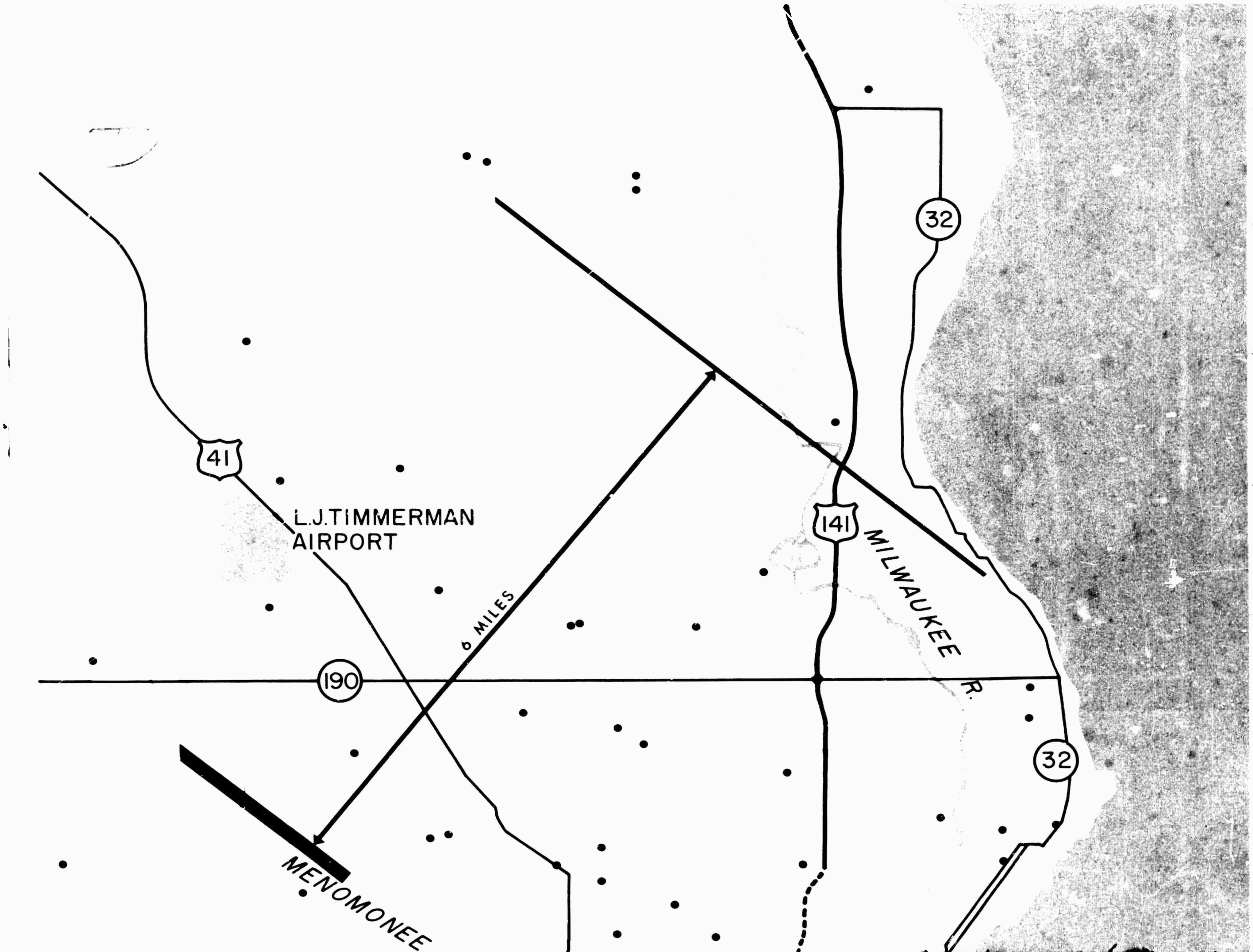
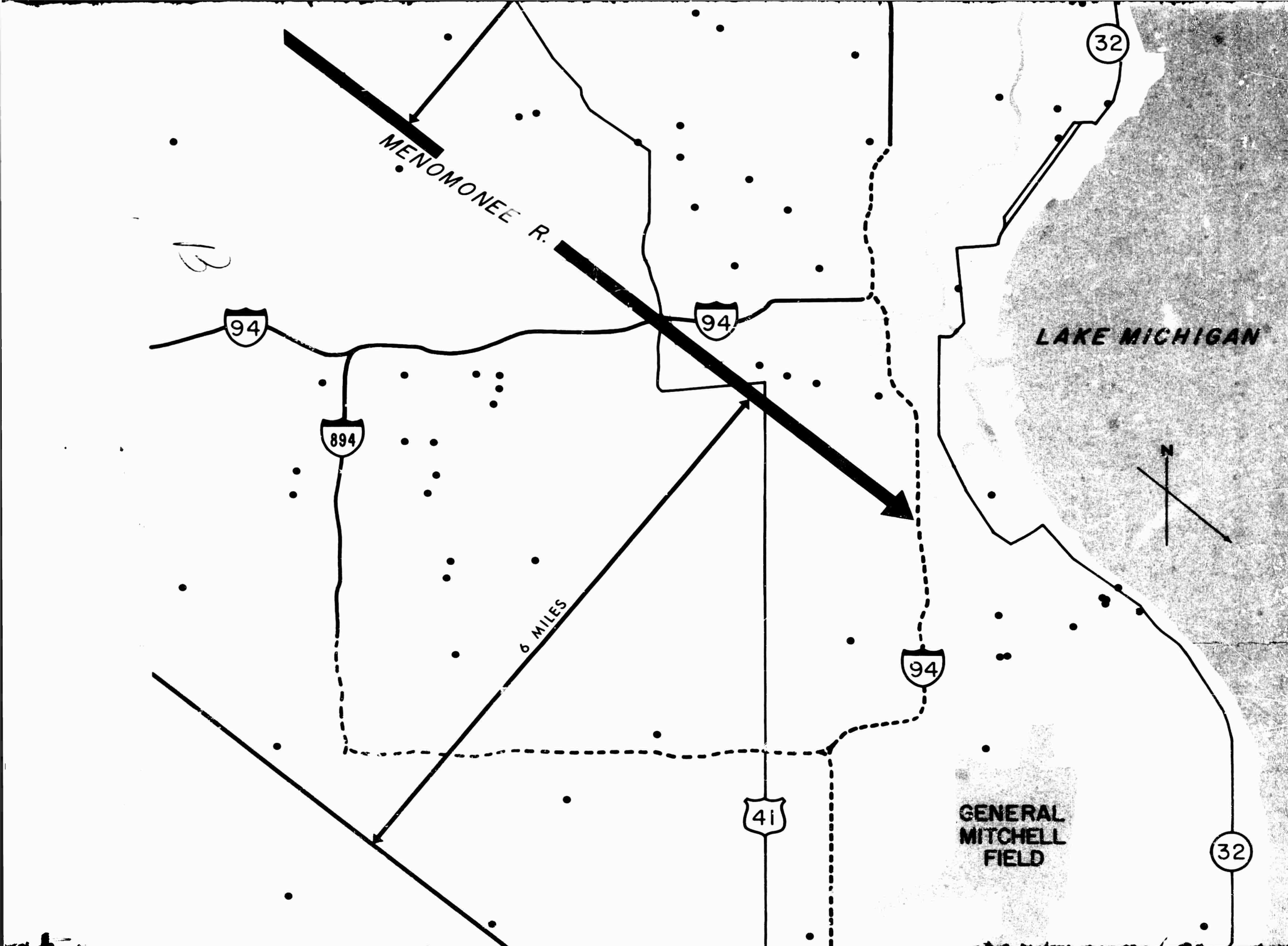


Figure B - 6

PITTSBURGH BOOM AREA
Other Damage

B


32
41
L.J.TIMMERMAN
AIRPORT
141
MILWAUKEE R.
6 MILES
190
32
MENOMONEE



MENOMONEE R.
B
94
94
894
6 MILES
LAKE MICHIGAN
N
32
94
41
GENERAL MITCHELL FIELD
32

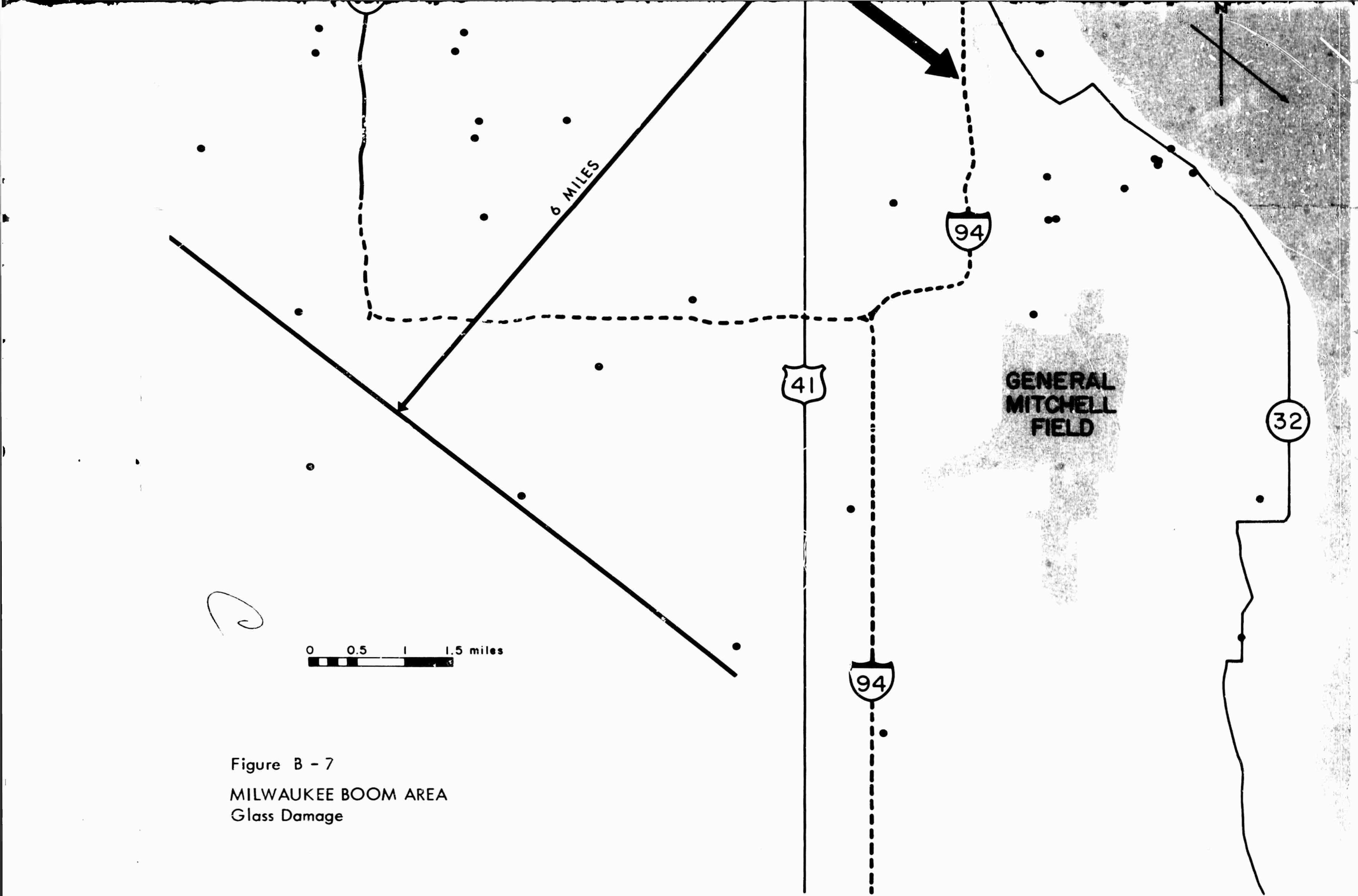
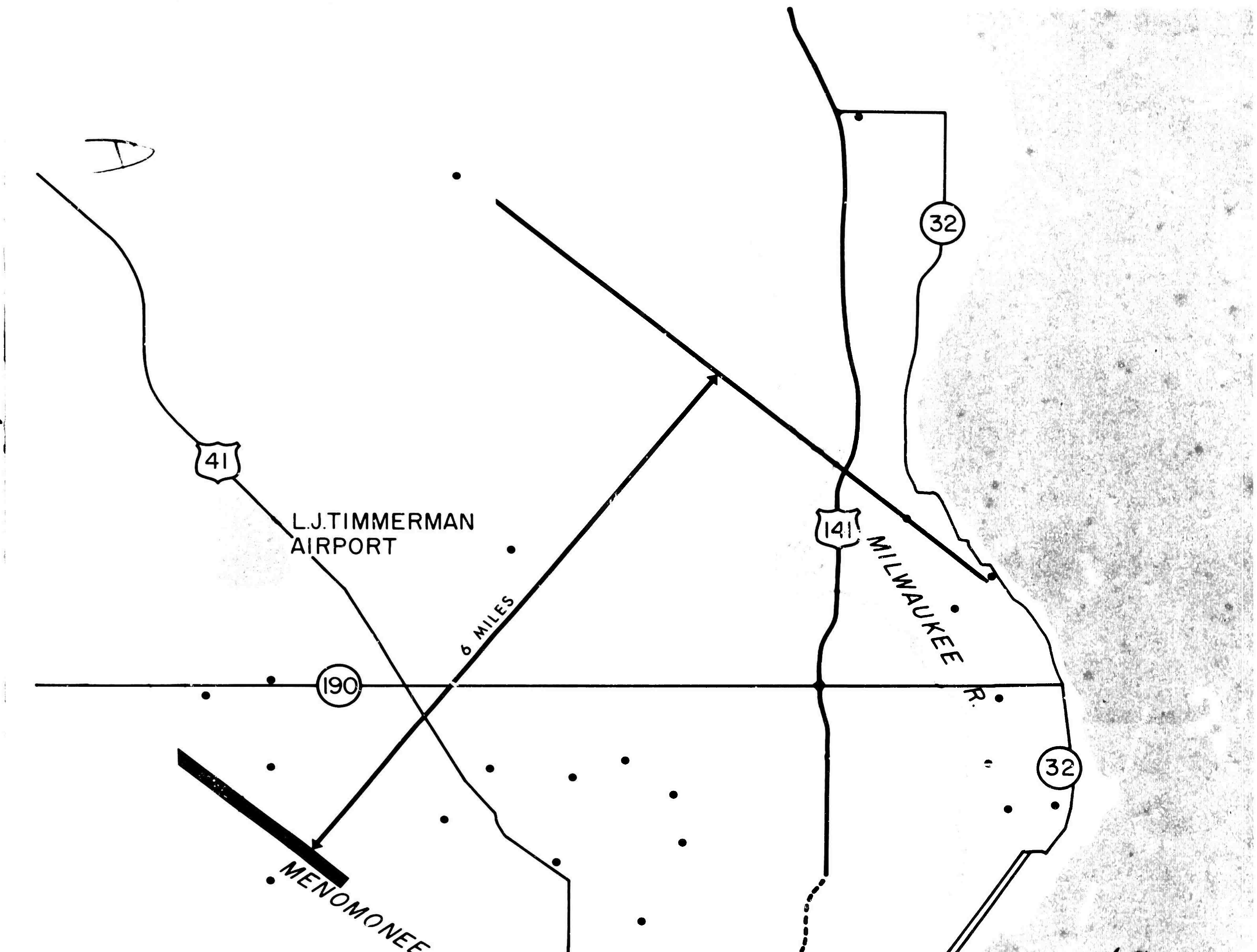
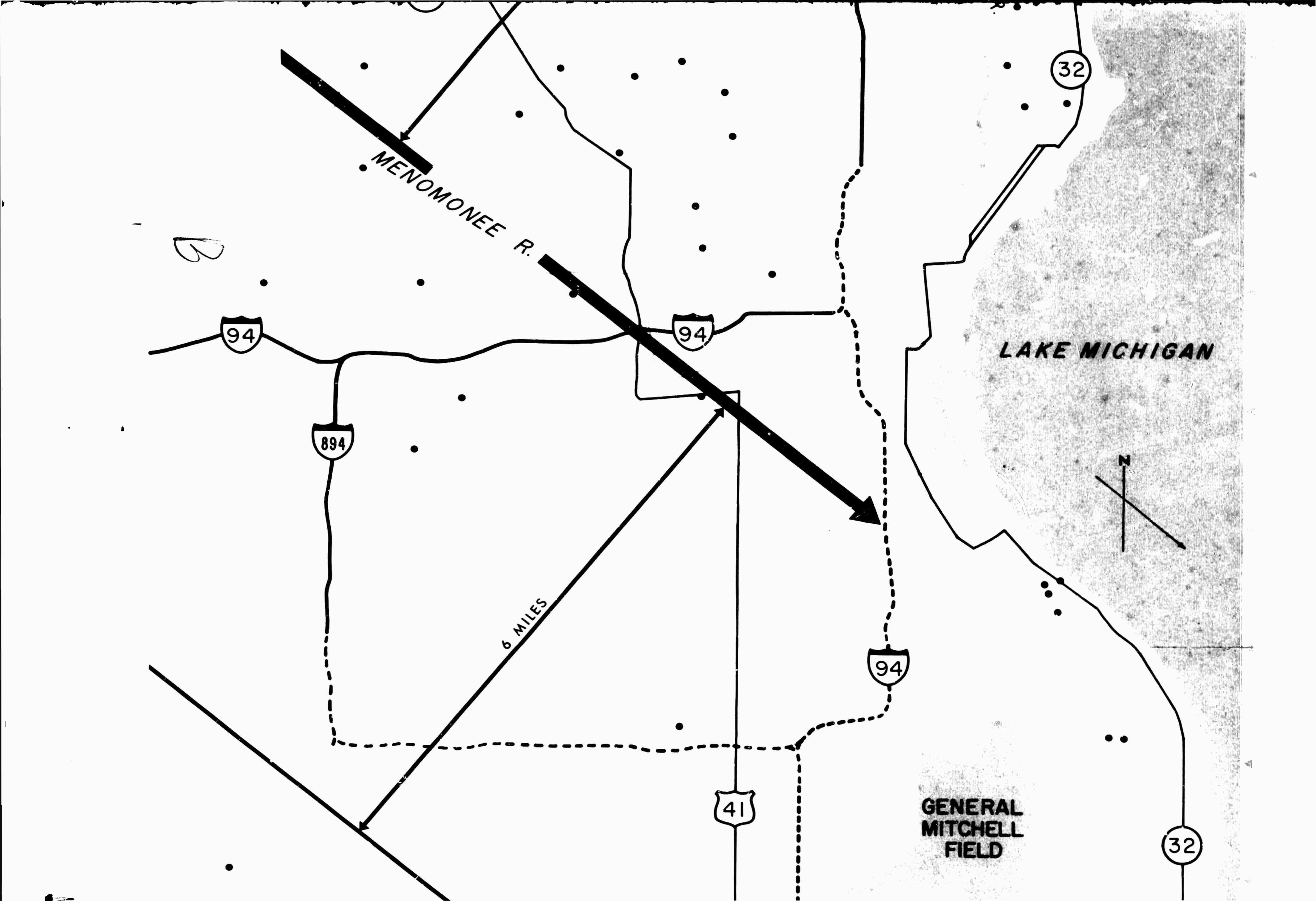


Figure B - 7

MILWAUKEE BOOM AREA
Glass Damage



A
32
41
L.J.TIMMERMAN
AIRPORT
6 MILES
190
141
MILWAUKEE R.
32
MENOMONEE



MENOMONEE R.
B
94
894
6 MILES
41
LAKE MICHIGAN
N
32
GENERAL MITCHELL FIELD

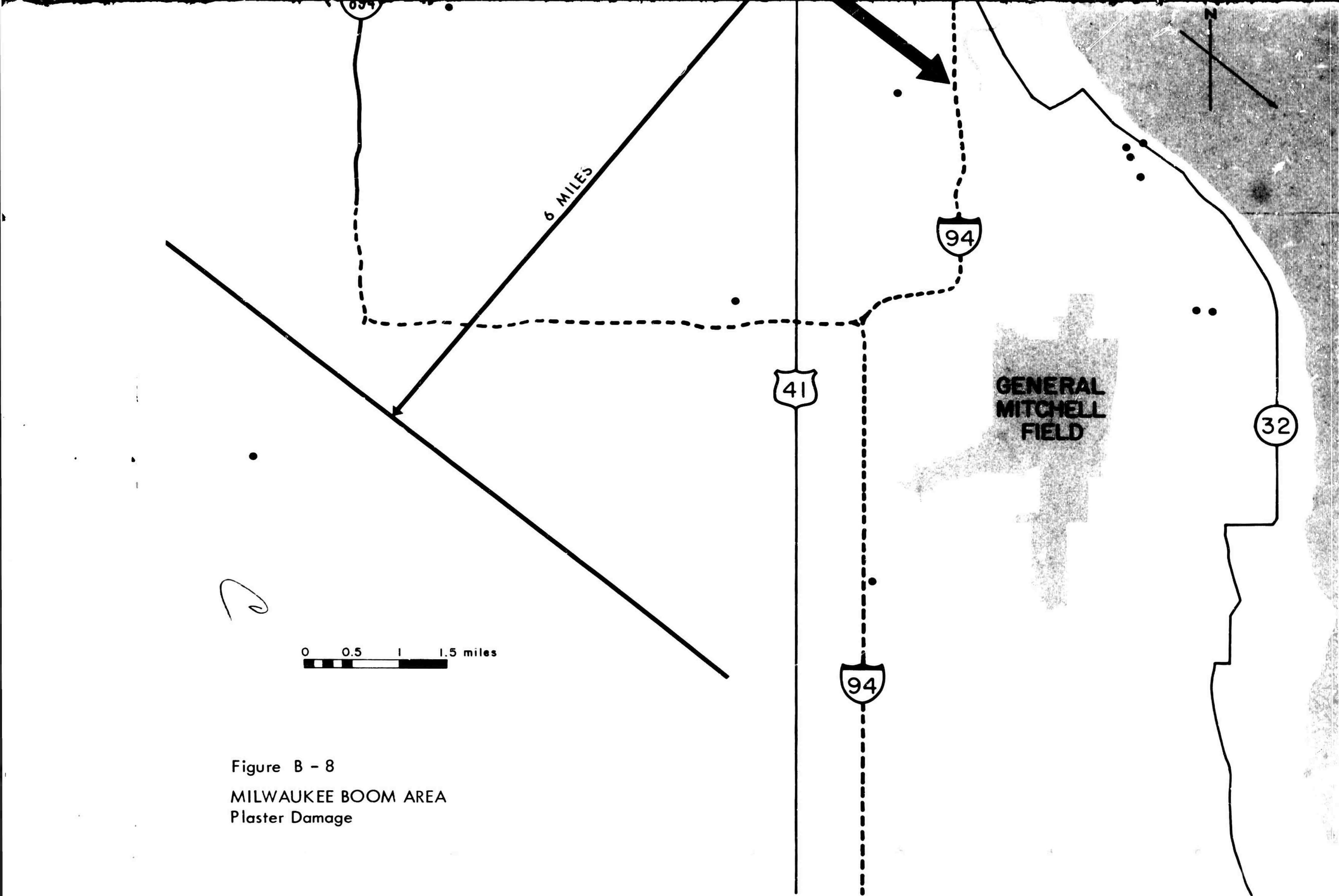
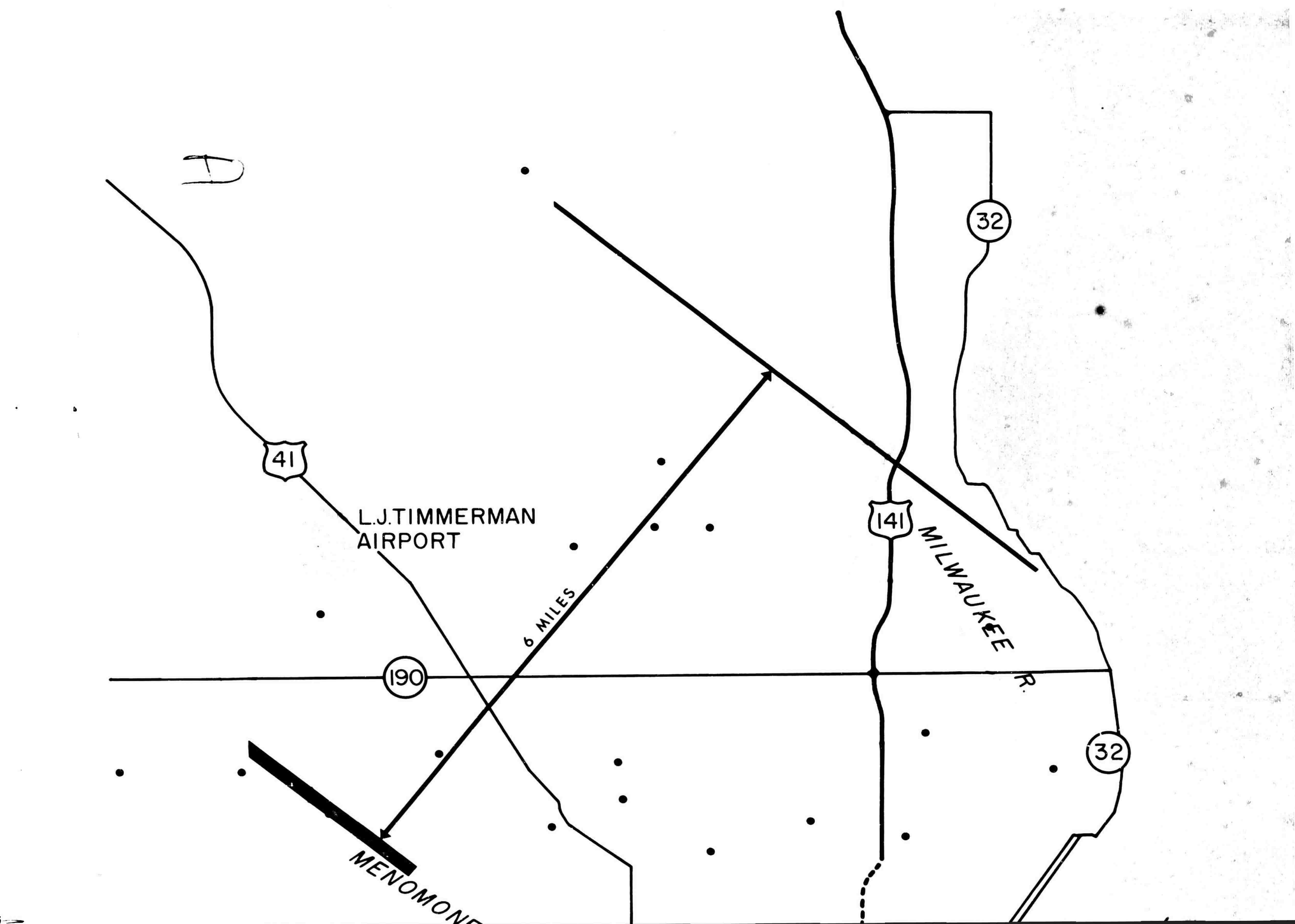
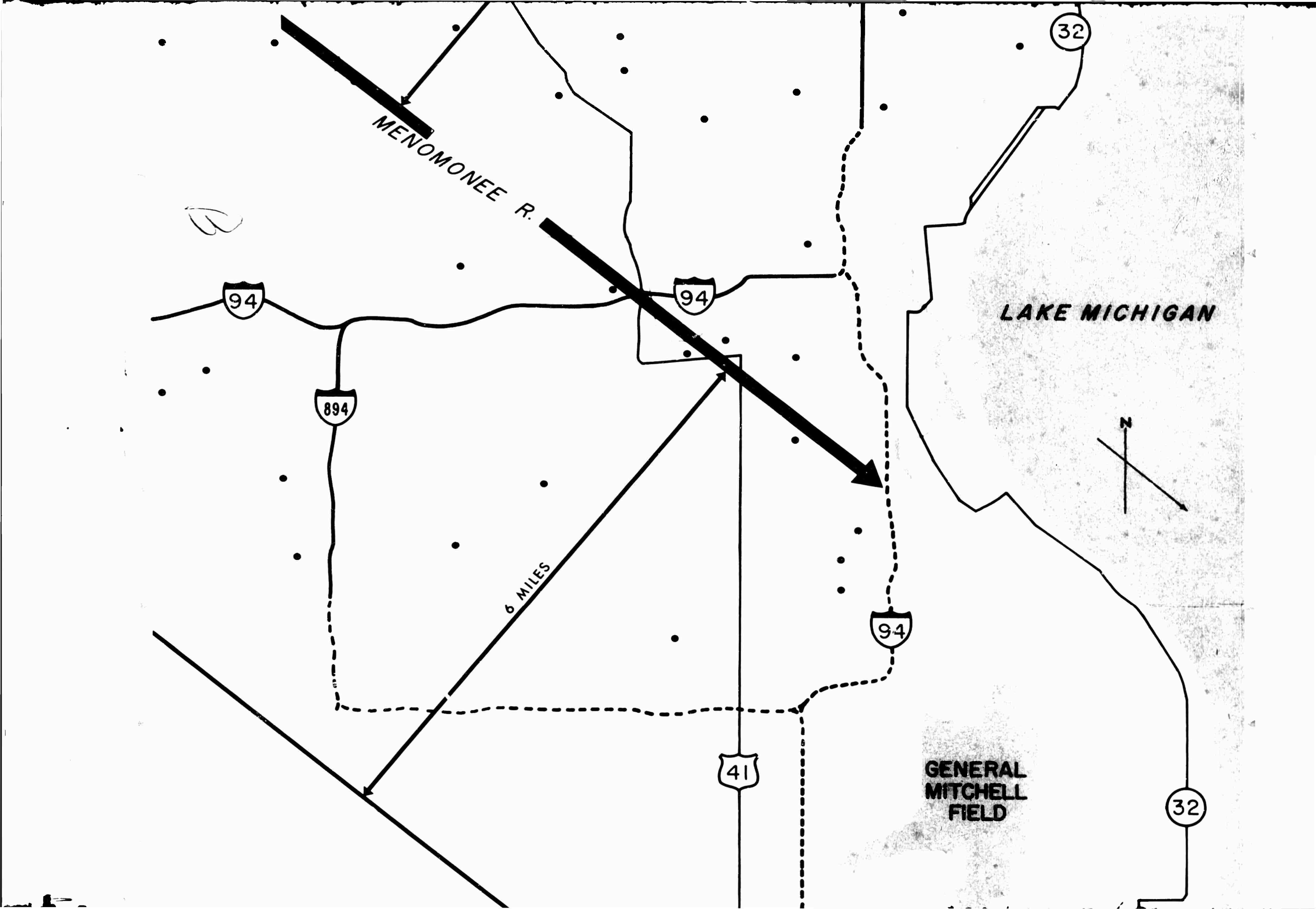


Figure B - 8

MILWAUKEE BOOM AREA
Plaster Damage



32
32
141
MILWAUKEE R.
41
L.J.TIMMERMAN
AIRPORT
6 MILES
190
MENOMONE
A



LAKE MICHIGAN
N
32
MENOMONEE R.
94
894
6 MILES
41
GENERAL
MITCHELL
FIELD

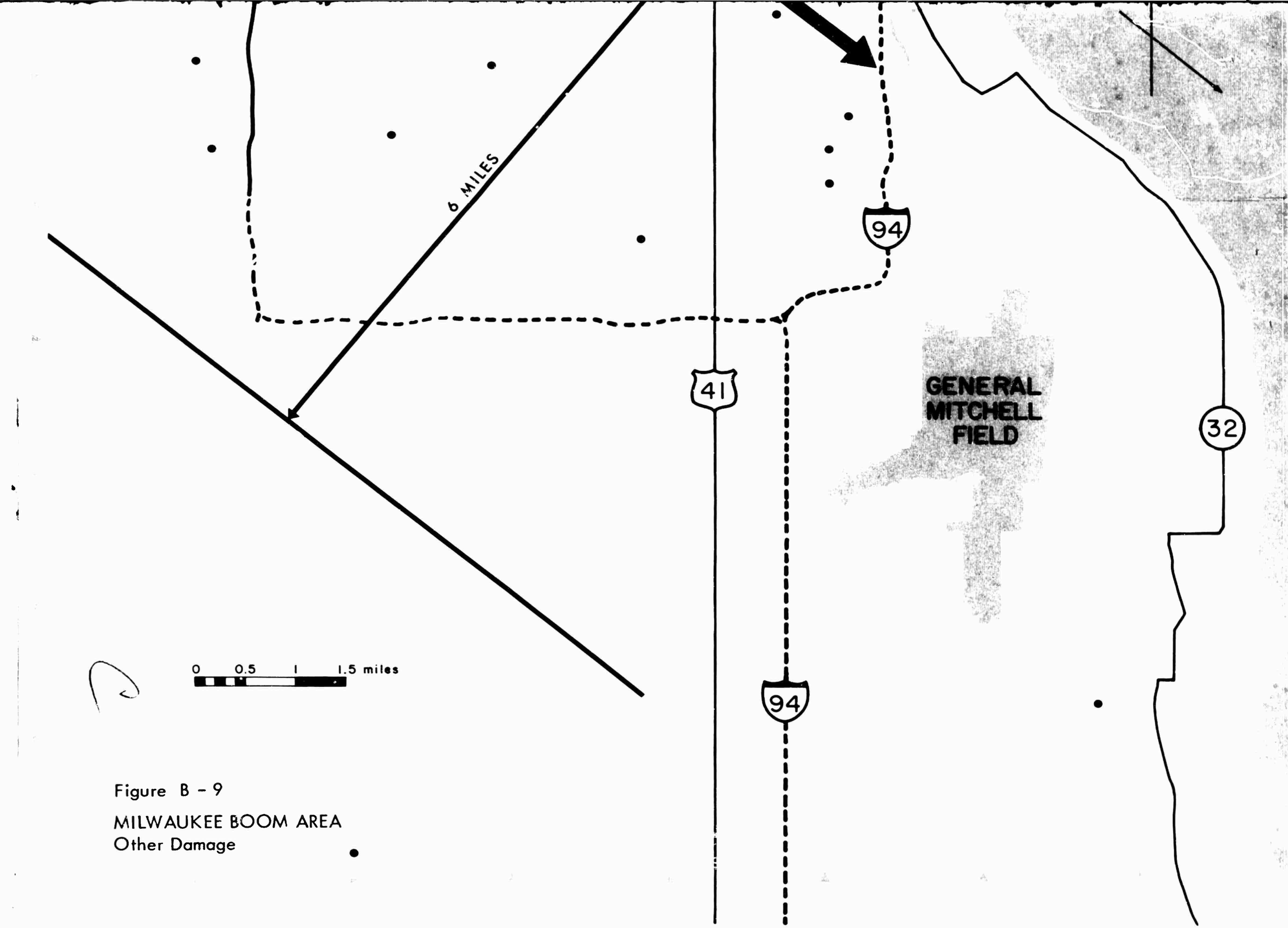
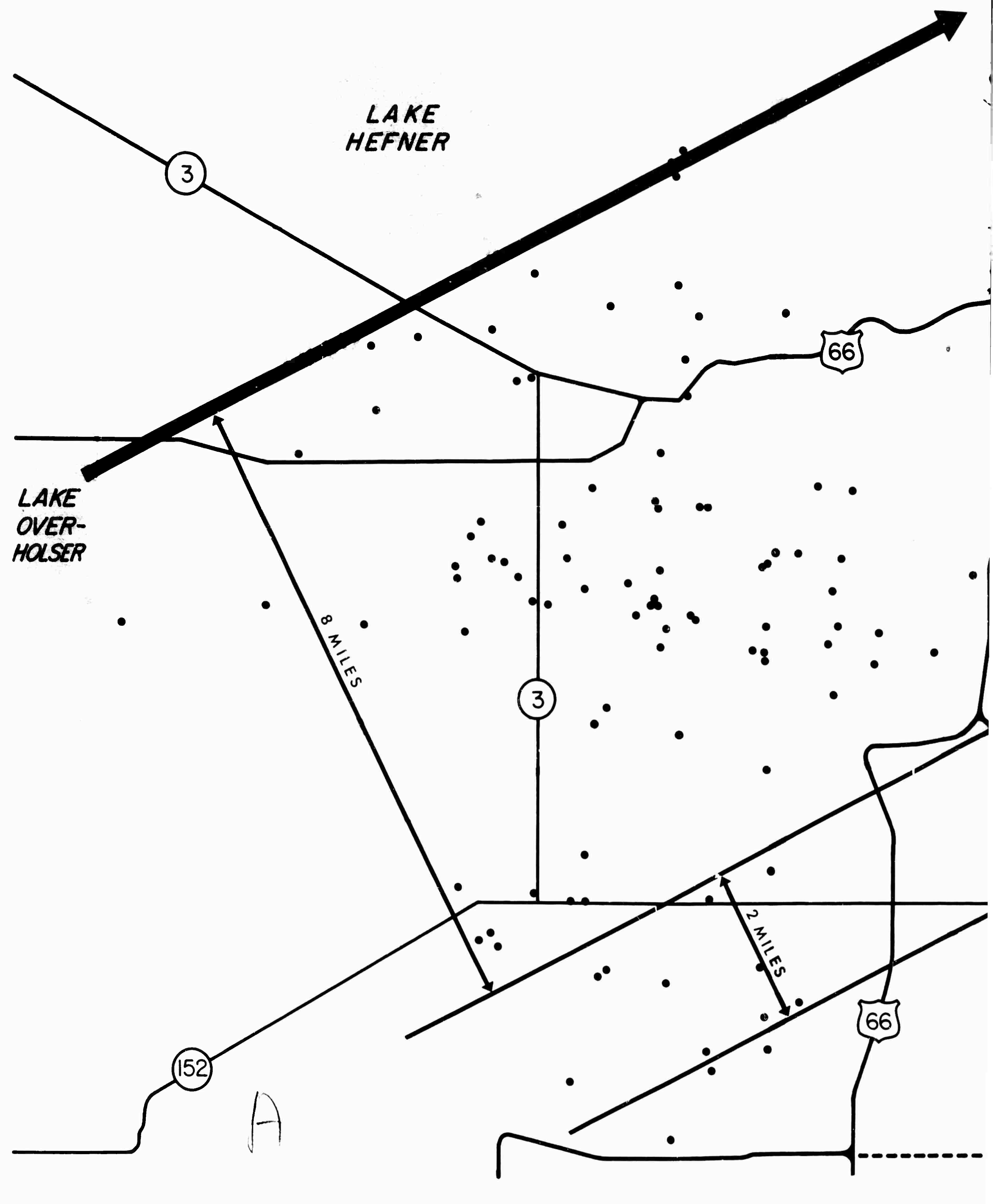


Figure B - 9

MILWAUKEE BOOM AREA
Other Damage



LAKE HEFNER
LAKE OVER-HOLSER
3
3
66
66
152
8 MILES
2 MILES
A

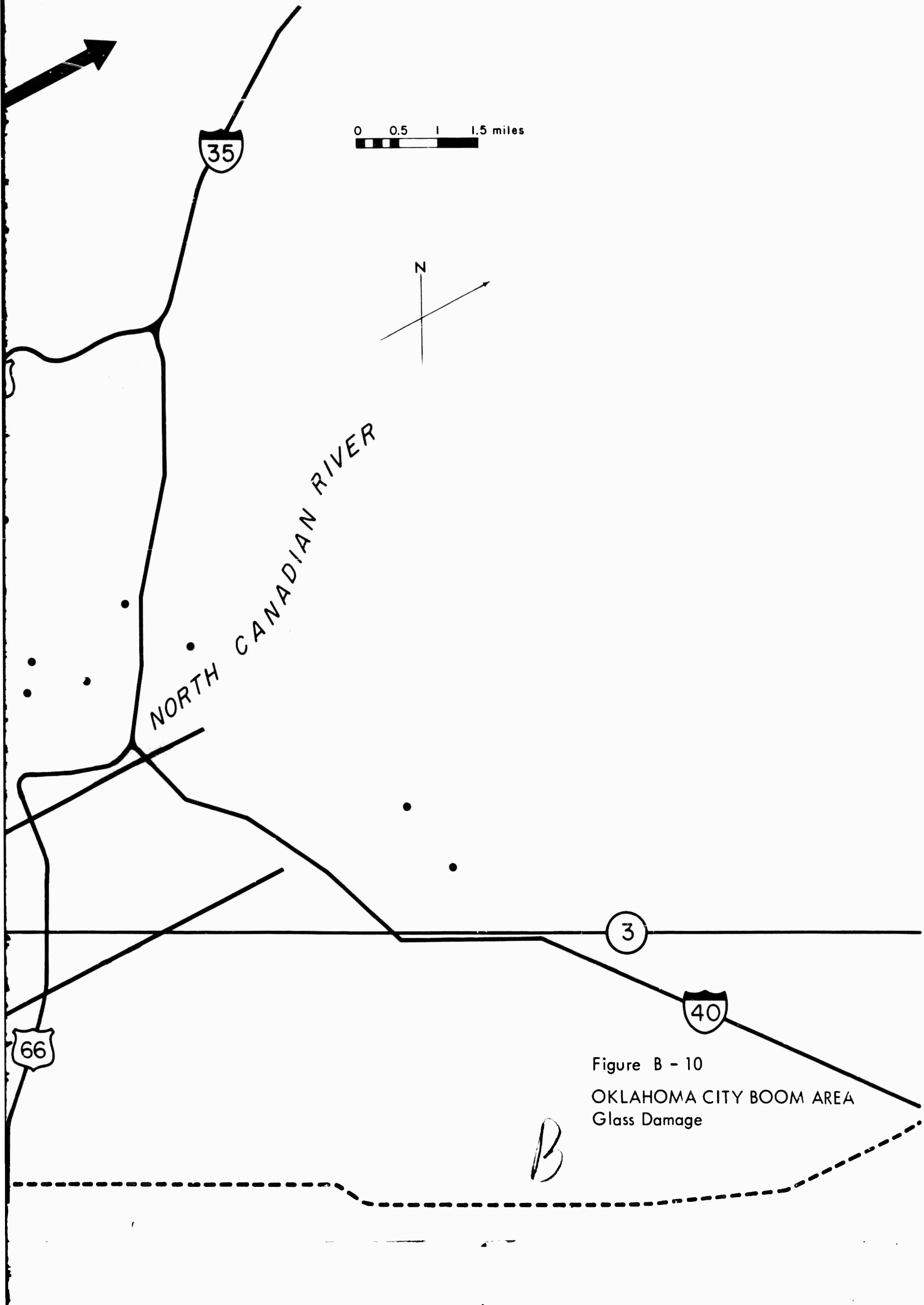
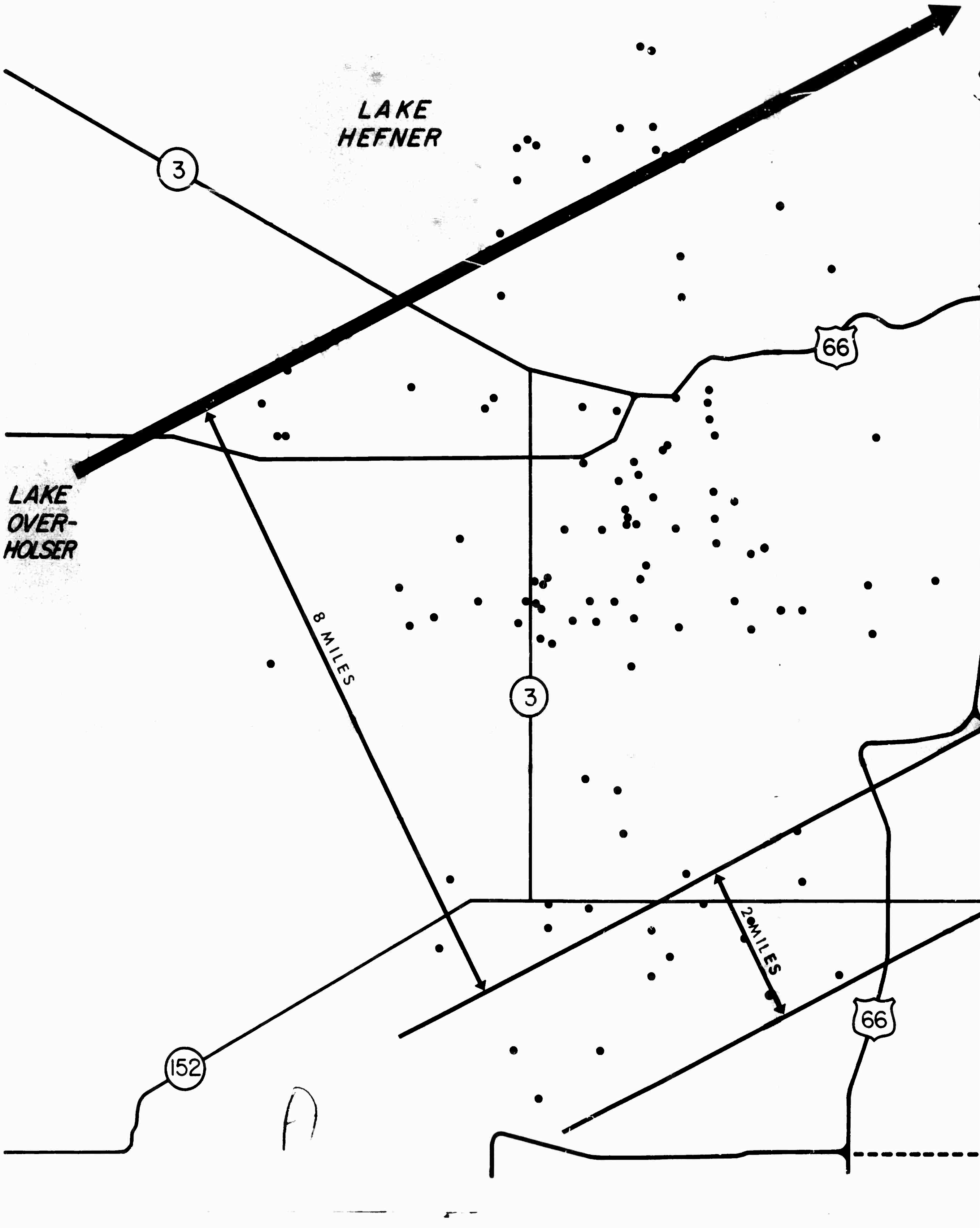


Figure B - 10

OKLAHOMA CITY BOOM AREA
Glass Damage


LAKE HEFNER
LAKE OVER-HOLSER
3
3
66
66
152
8 MILES
2 MILES
A

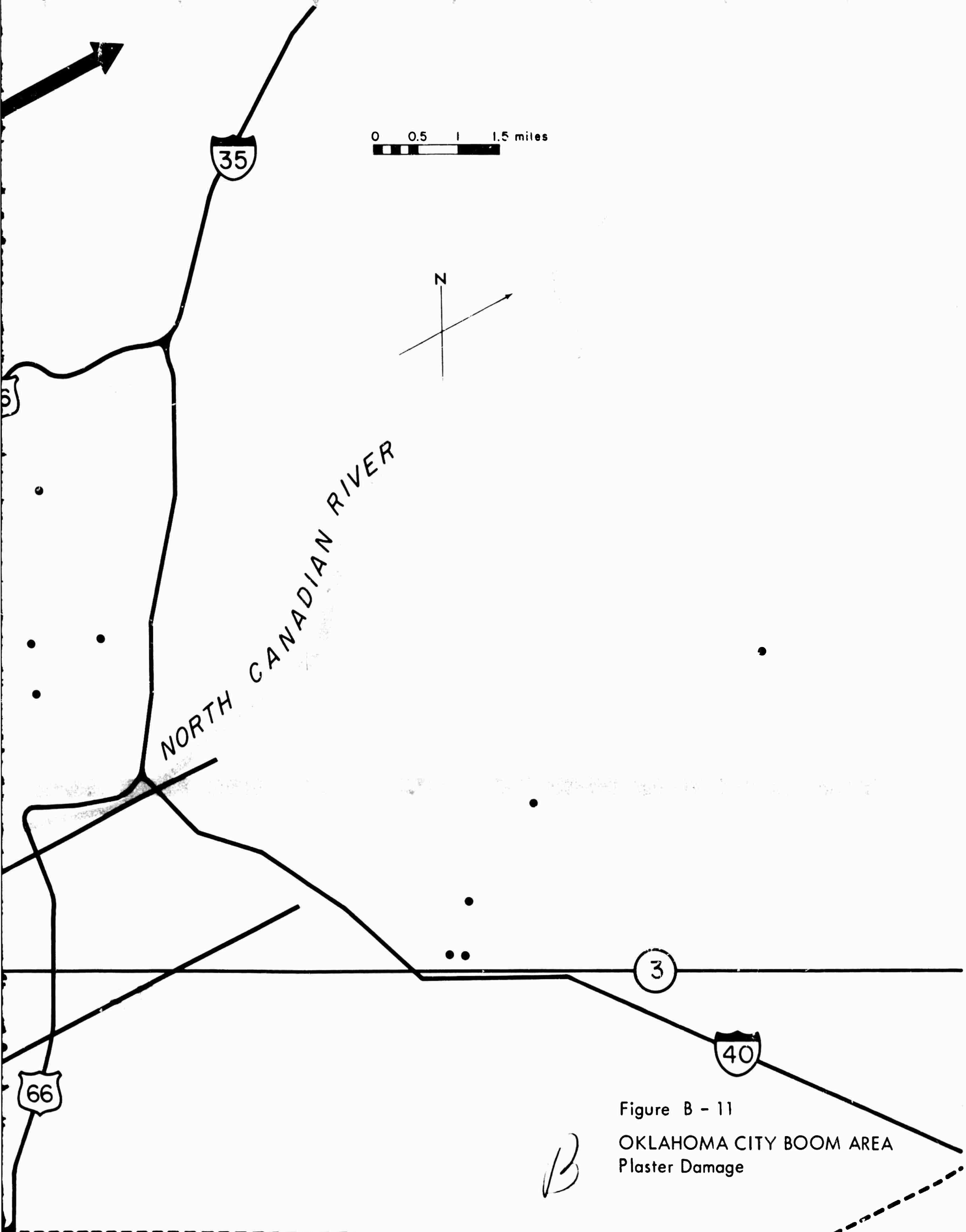
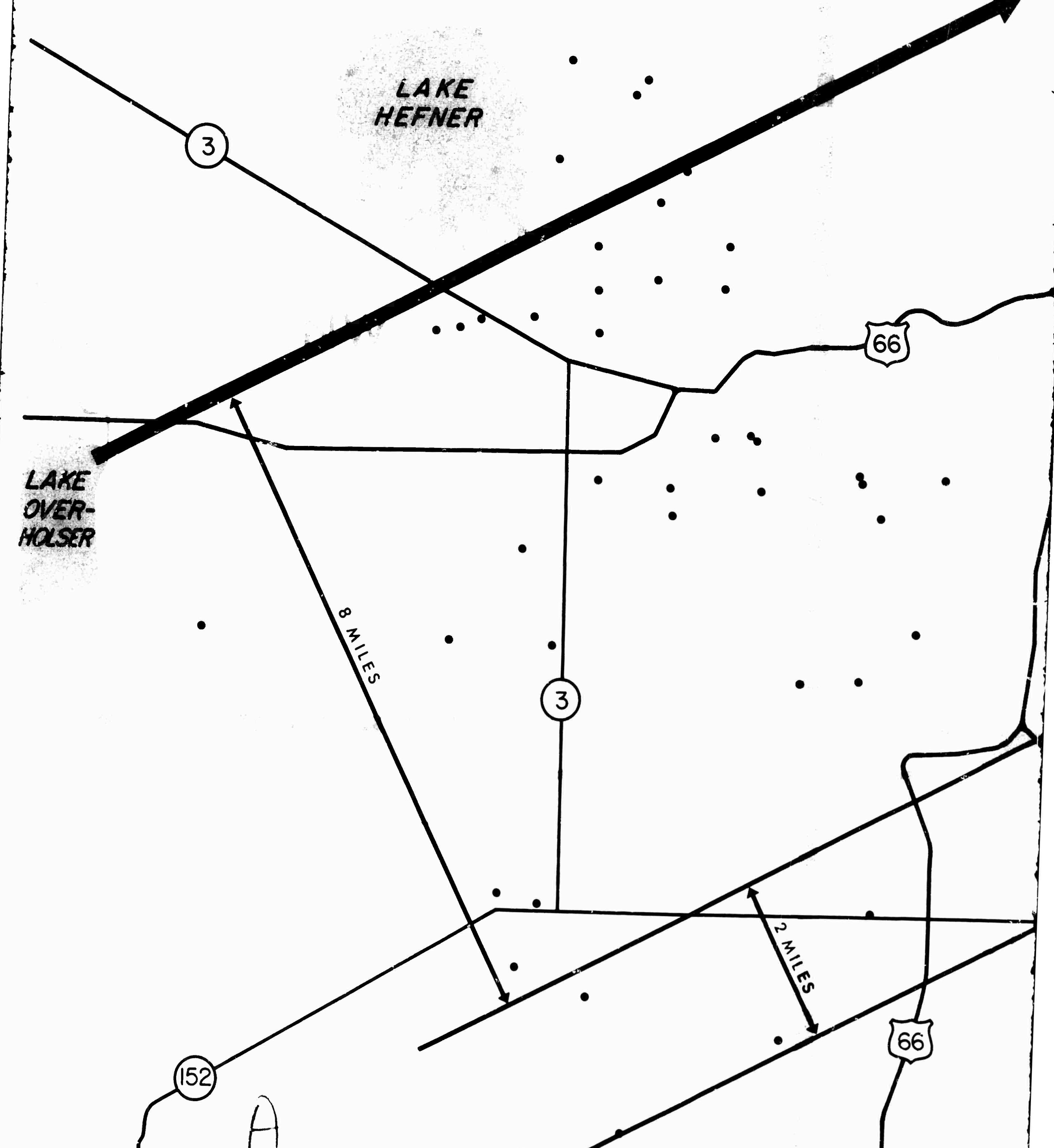


Figure B - 11

OKLAHOMA CITY BOOM AREA
Plaster Damage

B



LAKE HEFNER
LAKE OVER-HOLSER
3
66
8 MILES
3
2 MILES
152
66
A

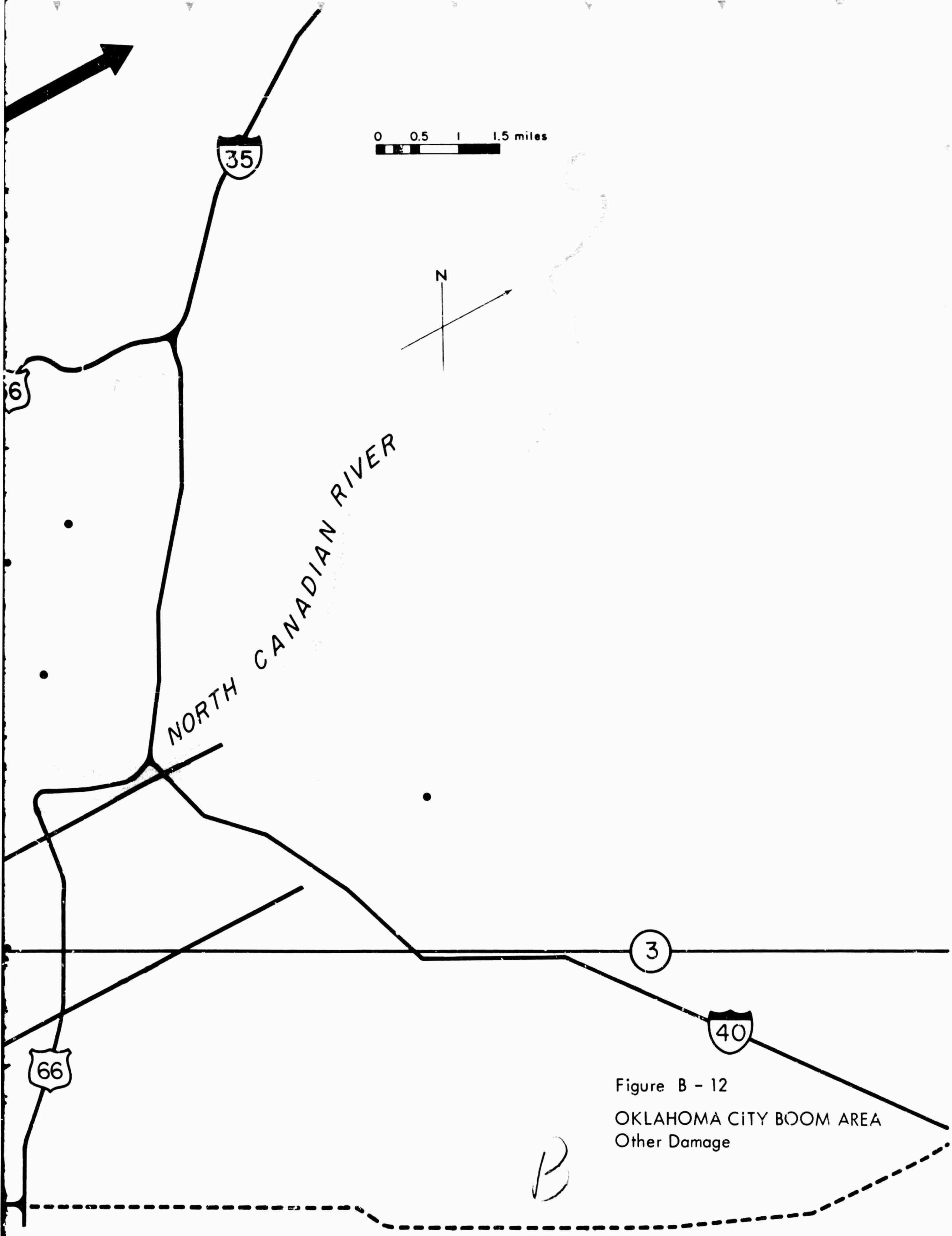


Figure B - 12

OKLAHOMA CITY BOOM AREA
Other Damage

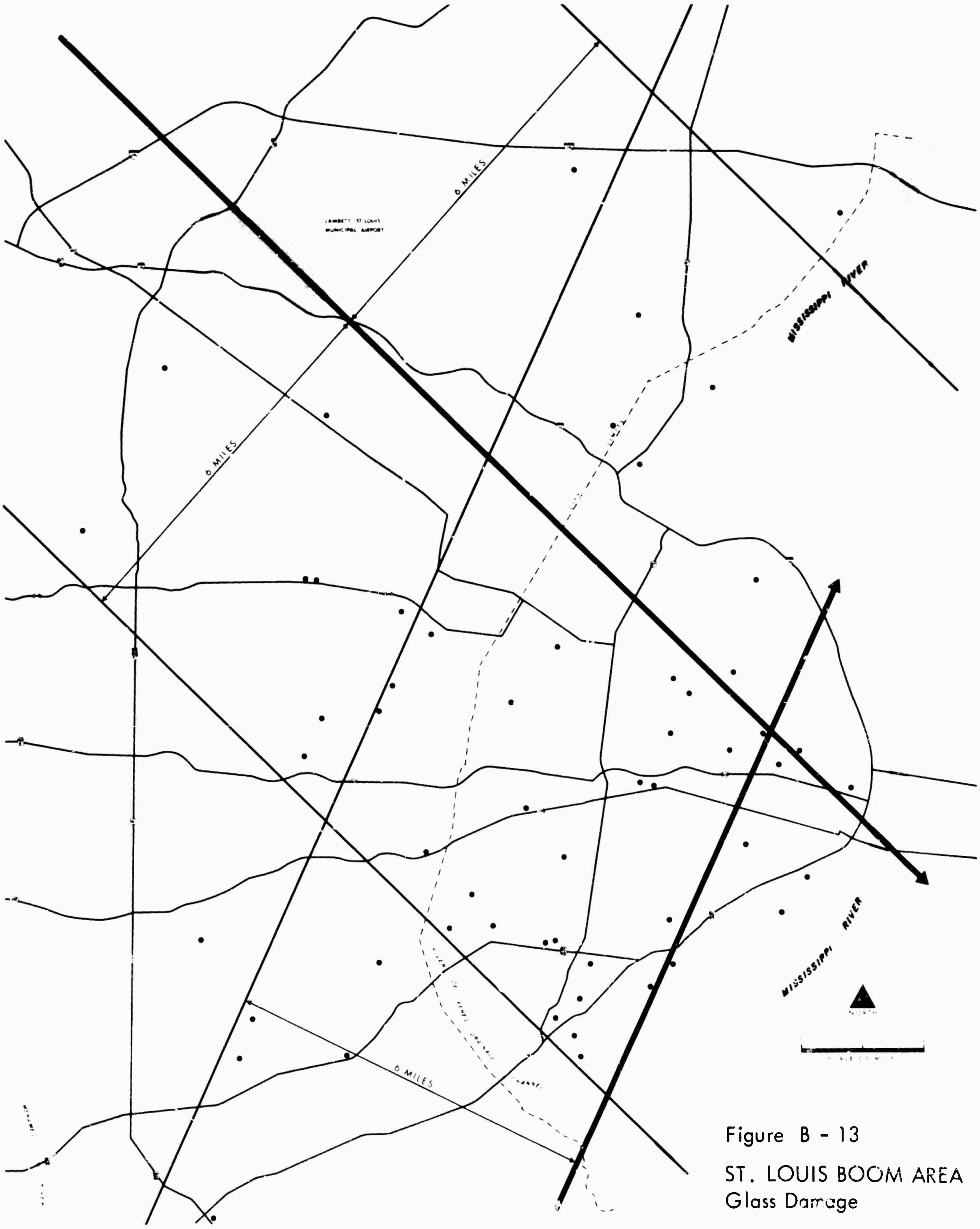


Figure B - 13
ST. LOUIS BOOM AREA
Glass Damage

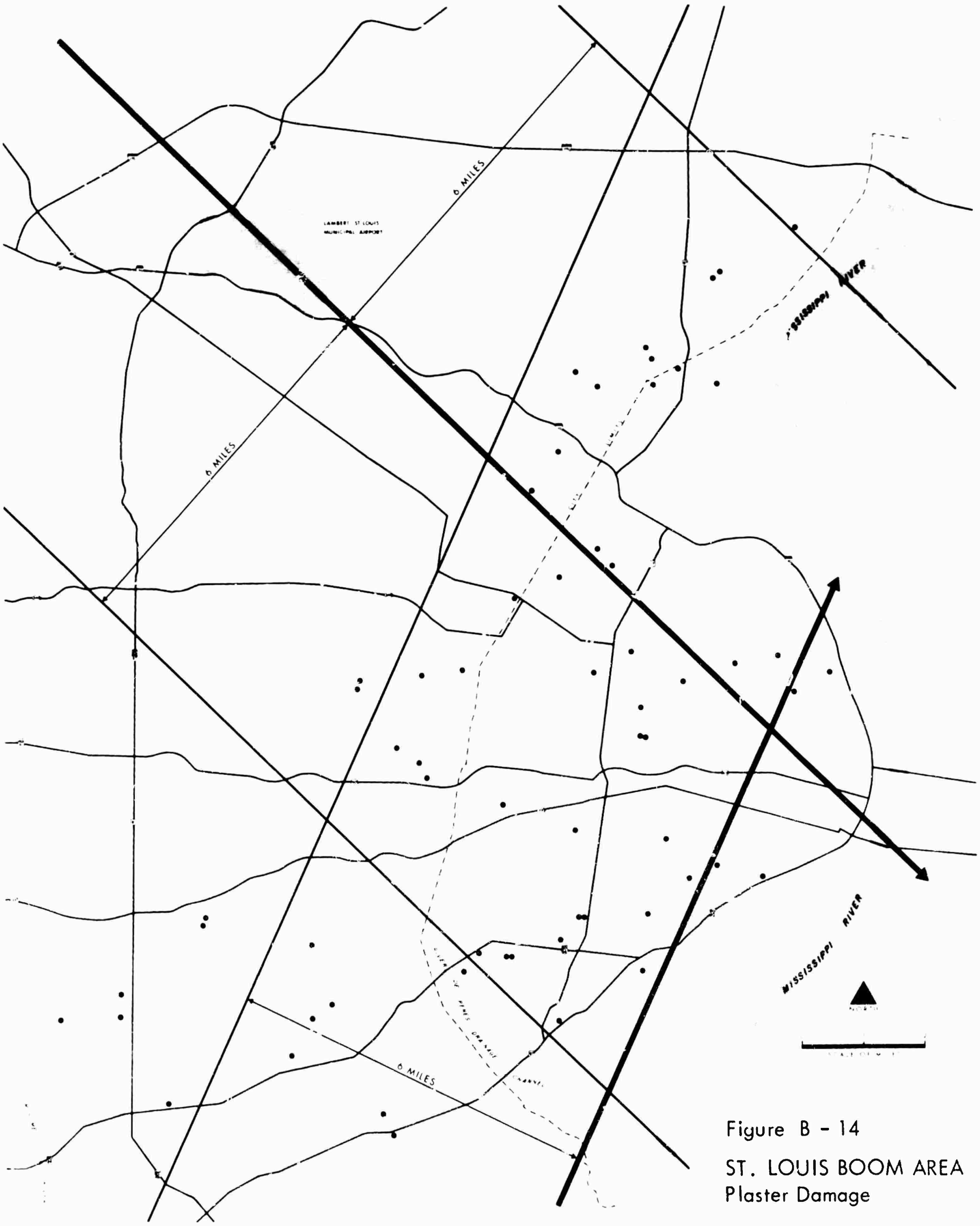


Figure B - 14
ST. LOUIS BOOM AREA
Plaster Damage

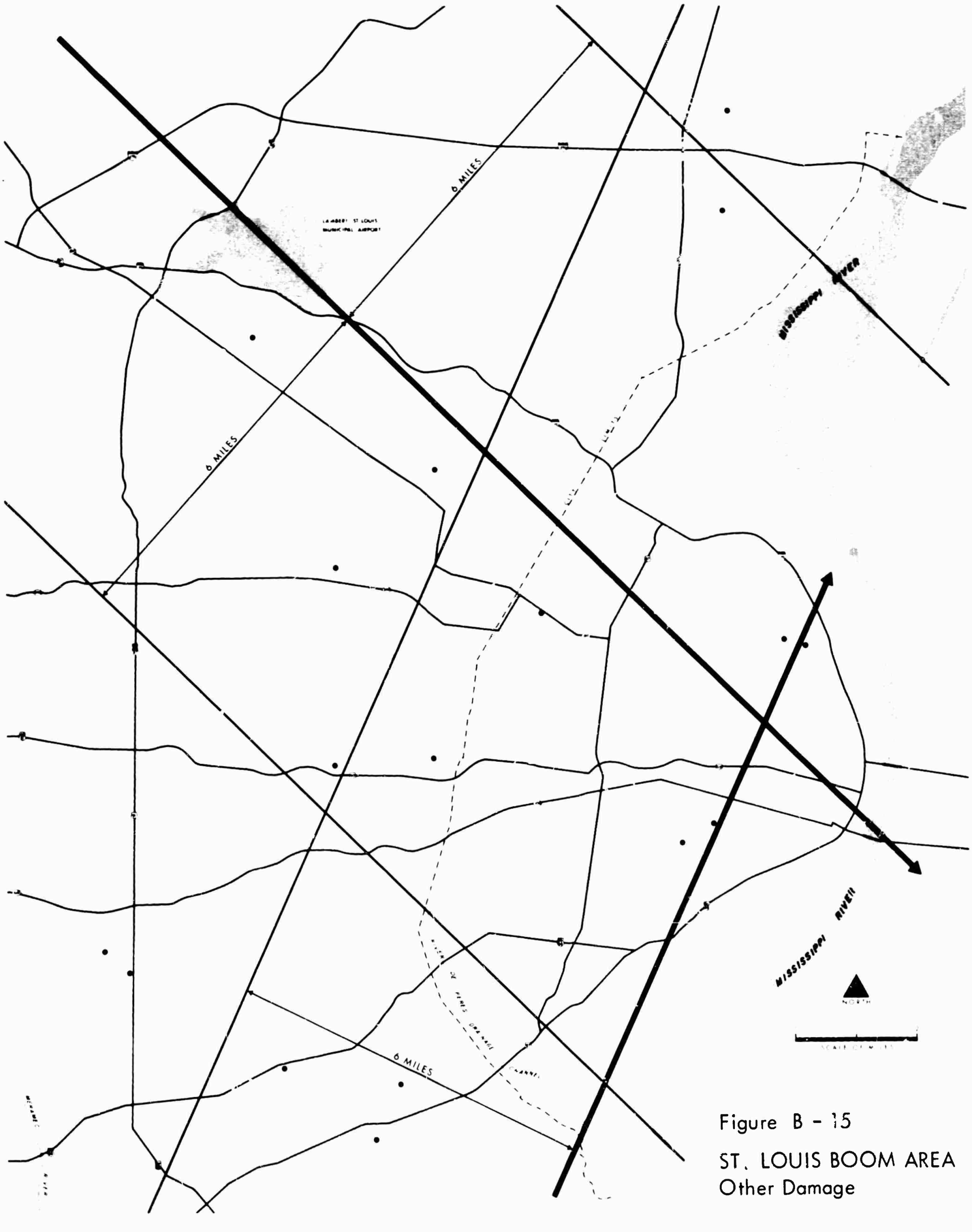


Figure B - 15
ST. LOUIS BOOM AREA
Other Damage

Appendix C

STARTLE EFFECT ON PEOPLE AND ANIMALS

Table C-1

STARTLE EFFECT ON PEOPLE AND ANIMALS

Area	Remarks	Amount Claimed	Amount Awarded
SBA	Personal injury to 84-year old woman; caused muscles in arm to tighten up.	$ 37	$ 37
SBA	Fracture and acute sprain of left wrist to 55-year old person.	50	50
OBA	Claimant alleges that sonic booms caused her to "black out" on several occasions. (60 years old.)	200	0
PBA	Claimant fell from ladder onto bedroom dresser and caused several items to fall to the floor and break.	134	0
FY66	Acute hysteria.	16	0
FY66	Claimant, who was disabled, fell and broke leg at time of double sonic boom. She used a mechanical walker, was walking to niece's car, and stepped over curb.	2,499	0
FY66	Mental aggravation to man and his dog; wants $10/month until booms stop.	--	0
FY66	Claimant pierced eardrum while cleaning ear at time of sonic boom.	50	0
FY66	Perforation of the right eardrum.	1,307	0
Animals			
FY66	Hereford steer trampled and killed when cattle stampeded.	$ 150	$ 150
FY66	Hereford heifer frightened and injured in going through fence; later died.	170	170
FY66	Heifer frightened and running caused lung to burst, resulting in death.	140	140
FY66	37 head of cattle stampeded and damaged fence; also required veterinarian for treating cattle.	100	25
FY66	Cattle.	--	80% paid

Table C-1
(continued)

Area	Remarks	Amount Claimed	Amount Awarded
FY66	Cattle stampede which caused cow to have a miscarriage.	$ 225	$ 0
FY66	8 cows frightened and ran through fence and damaged corn field.	200	0
FY66	8 head of cattle frightened and had to be sold by owner. (Also see #HAF66/50006)	476	0
FY66	265 mink kits killed by their mothers.	$5,300	$2,130
FY66	55 mink frightened and destroyed young.	1,100	296
FY66	239 female mink became frightened resulting in a loss of 250 kits.	4,782	1,912
FY66	160 mink frightened--female mink ceased to lactate and starved young.	2,400	0
FY66	Rabbits frightened and killed their young and themselves.	$ 150	$ 0
FY66	Rabbits frightened and killed their young.	160	0
FY66	Arabian colt ran into barbed wire fence, cutting itself, and reduced value.	$2,500	$ 0
SBA	Pony jumped and broke leg; had to be killed.	85	85
SBA	Dog ran through glass pane in door and cut itself.	$ 50	$ 48
CBA	Pup.	100	100
FY66	French poodle male dog became very upset and ran about house biting and pulling on drapes and shower curtain.	128	0

Table C-1
(concluded)

Area	Remarks	Amount Claimed	Amount Awarded
FY66	411 chickens 6-weeks old piled up in corner and suffocated.	$1,027	$ 0
PBA	Hatchery--75 eggs--failure of hens to hatch the eggs.	100	0
OBA	Egg production affected; eggs cracked, showing blood spots.	676	0
OBA	2,000 game bird eggs are not hatching properly in incubator.	700	0
PBA	Eggs.	69	0
FY66	47 geese and 35 duck eggs failed to hatch.	85	0

Appendix D

FISCAL YEAR 1966, CLAIMS SUMMARY

(I

	MAA				MOA*				OCA					
	Paid		Denied		Paid		Denied		Paid		Denied		Paid	
	Number	% of Category	Number	% of Category	Number	% of Category	Number	% of Category	Number	% of Category	Number	% of Category	Number	% of Category
Claims	19	49 %	20	51 %	168	61 %	107	39 %	166	48 %	179	52 %	50	52
Damage incidents	20	44	25	56	211	60	139	40	176	45	219	55	52	49
Average damage incidents per claim	1.05		1.25		1.26		1.30		1.06		1.22		1.04	
Single family	12	60	24	100	165	78	117	87	104	62	160	78	27	54
Multifamily	--	--	--	--	2	1	4	3	7	4	3	1	1	2
Commercial	8	40	--	--	44	21	13	10	58	34	41	21	22	44
Other	--		1		--		5		7		15		2	
Total damage														
Glass	14	70	5	20	138	66	31	22	121	69	65	30	39	75
Plaster	5	25	11	44	30	14	37	27	36	20	62	28	6	12
Fallen objects	1	5	--	--	15	7	3	2	9	5	8	4	4	7
Miscellaneous	--	--	9	36	28	13	68	49	10	6	84	38	3	6
Average damage cost														
Glass	$110		$ 33		$ 74		$107		$108		$110		$105	
Plaster	376		255		279		368		288		350		253	
Fallen objects	15		--		74		130		55		70		200	
Miscellaneous	148		247		501		598		712		660		392	
Single family														
Glass	7	58	5	21	94	57	17	14	62	59	33	21	16	59
Plaster	4	33	11	46	30	18	35	30	33	32	58	36	6	22
Fallen objects	1	9	--	--	15	9	2	2	6	6	8	5	3	11
Miscellaneous	--	--	8	33	26	16	63	54	3	3	61	38	2	8
Single family glass														
<2 feet	5	71	3	60	37	41	6	40	17	28	16	53	2	12
2-4 feet	2	29	1	20	46	51	4	27	36	60	8	27	6	38
>4 feet	--	--	1	20	7	8	5	33	7	12	6	20	8	50
Average panes broken/single family glass incident	3.8†		2.6		3.5‡		4.1		3.6		2.5§		1.6	
Single family														
<25 years old	3	30	10	56	54	59	57	71	42	65	74	58	16	67
>25 years old	7	70	8	44	38	31	23	29	23	35	54	42	8	33
Sample size	10	(83)	18	(75)	92	(56)	80	(68)	65	(62)	128	(80)	24	(89)
Commercial														
Glass	7	88	--	--	42	95	11	84	55	95	29	71	21	95
Plaster	1	12	--	--	--	--	--	--	--	--	3	7	--	--
Fallen objects	--	--	--	--	--	--	1	8	2	3	--	--	1	5
Miscellaneous	--	--	--	--	2	5	1	8	1	2	9	22	--	--
Commercial glass - >4 feet	6	86	--	--	38	91	9	82	46	83	21	72	15	71
Condition of structures (all)														
DD	--	--	2	11	24	17	9	10	2	2	23	13	1	2
FR	8	57	4	21	42	30	30	33	15	13	44	25	9	20
SD	6	43	13	68	75	53	52	57	99	85	109	62	36	78
Sample size	14	(70)	19	(79)	141	(67)	91	(68)	116	(69)	176	(86)	46	(92)

* Includes 32 paid claims from Washington Court House.
† Does not include 2 claims of 120 panes.
‡ Does not include 1 claim of 61 panes.
§ Does not include 2 claims of 54 panes.
** Does not include 4 claims of 76 panes.
†† Does not include 1 claim of 23 panes.

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Table D-1

FISCAL YEAR 1966 CLAIMS SUMMARY
(Includes Claims over $1,000 and Appeals)

	OOA				SAA				SMA				WPB*					
nied	Paid		Denied		Paid		Denied		Paid		Denied		Paid		Denied		Paid	
% of Category	Number	% of Category	Number	% of Category	Number	% of Category	Number	% of Category	Number	% of Category	Number	% of Category	Number	% of Category	Number	% of Category	Number	% of Cate
52 %	50	52 %	46	48 %	35	51 %	33	49 %	191	45 %	231	55 %	56	67 %	27	33 %	36	4
55	52	49	54	51	37	44	48	56	212	43	279	57	59	63	35	37	40	3
	1.04		1.17		1.06		1.45		1.11		1.21		1.05		1.30		1.11	
78	27	54	37	77	19	51	37	79	135	66	202	76	40	69	25	76	16	40
1	1	2	--	--	1	3	--	--	4	2	16	6	2	3	1	3	1	
21	22	44	11	23	17	46	10	21	65	32	47	18	16	28	7	21	23	58
	2		6		--		1		8		14		1		2		--	
30	39	75	15	28	31	84	8	17	163	77	95	34	47	80	13	37	28	70
28	6	12	17	31	3	8	11	23	14	6	76	27	5	8	12	34	8	20
4	4	7	1	2	2	5	2	4	12	6	16	6	2	4	1	3	1	
38	3	6	21	39	1	3	27	56	23	11	92	33	5	8	9	26	3	8
	$105		$ 138		$ 90		$ 205		$ 95		$100		$ 87		$ 224		$142	
	253		320		1,093		802		207		346		246		1,078		213	
	200		7		46		38		72		178		56		100		2	
	392		1,188		125		1,225		155		1,227		1,130		3,145		196	
21	16	59	6	16	13	68	3	8	96	71	53	26	31	78	6	24	5	31
36	6	22	17	46	3	16	11	30	13	10	67	33	5	12	12	48	8	50
5	3	11	--	--	2	11	1	3	8	6	11	6	2	5	1	4	1	6
38	2	8	14	38	1	5	22	59	18	13	71	35	2	5	6	24	2	13
53	2	12	2	33	1	8	2	67	19	21	13	26	9	29	2	33	1	25
27	6	38	1	17	8	67	--	--	47	51	21	43	20	65	3	50	3	75
20	8	50	3	50	3	25	1	33	26	28	15	31	2	6	1	17	--	--
	1.6		1.8		2.0		2.7		2.1		2.4		2.7**		6.3		4.0	
58	16	67	18	60	11	69	25	68	68	78	126	81	2	14	3	15	5	50
42	8	33	12	40	5	31	12	32	19	22	30	19	12	86	17	85	5	50
(80)	24	(89)	30	(81)	16	(84)	37	(100)	87	(64)	156	(77)	14	(35)	20	(80)	10	(63
71	21	95	7	76	17	100	4	40	57	88	29	62	14	87	4	57	22	96
7	--	--	--		--	--	--	--	1	1	4	8	--	--	--	--	--	--
--	1	5	1	11	--	--	1	10	3	5	2	4	--	--	--	--	--	--
22	--	--	3	33	--	--	5	50	4	6	12	26	2	13	3	43	1	4
72	15	71	7	100	17	100	4	100	52	91	23	79	11	79	2	67	19	86
13	1	2	4	9	--	--	9	21	1	1	20	9	1	5	6	22	--	--
25	9	20	17	38	1	3	14	33	10	8	43	21	5	25	12	45	1	4
62	36	78	24	53	29	97	20	46	115	91	146	70	14	70	9	33	24	96
(86)	46	(92)	45	(94)	30	(31)	43	(91)	126	(62)	209	(79)	20	(35)	27	(82)	25	(62

β

SMA			WPB*				WRA				TOTAL					
	Denied		Paid		Denied		Paid		Denied		Paid		Denied		Total	
% of Category	Number	% of Category	Number	% of Category	Number	% of Category	Number	% of Category	Number	% of Category	Number	% of Category	Number	% of Category	Number	% of Category
45 %	231	55 %	56	67 %	27	33 %	36	44 %	45	56 %	721	51.2 %	688	48.8 %	1,409	100 %
43	279	57	59	63	35	37	40	38	64	62	807	48.4	863	51.6	1,670	100
	1.21		1.05		1.30		1.11		1.42		1.12		1.25		1.19	
66	202	76	40	69	25	76	16	40	52	83	518	66	654	80	1,172	73
2	16	6	2	3	1	3	1	2	2	3	18	2	26	3	44	3
32	47	18	16	28	7	21	23	58	9	14	253	32	138	17	391	24
	14		1		2		--		1		18		45		63	
77	95	34	47	80	13	37	28	70	12	19	581	72	244	28	825	49
6	76	27	5	8	12	34	8	20	22	34	107	13	247	29	354	21
6	16	6	2	4	1	3	1	2	4	6	46	6	35	4	81	5
11	92	33	5	8	9	26	3	8	26	41	73	9	337	39	410	25
	$100		$ 87		$ 224		$142		$ 71		$ 95		$113		$101	
	346		246		1,078		213		693		292		431		389	
	178		56		100		2		182		76		135		101	
	1,227		1,130		3,145		196		634		444		931		845	
71	53	26	31	78	6	24	5	31	7	13	324	63	130	20	454	39
10	67	33	5	12	12	48	8	50	20	39	102	20	231	35	333	28
6	11	6	2	5	1	4	1	6	2	4	38	7	25	4	63	5
13	71	35	2	5	6	24	2	13	23	44	54	10	268	41	322	28
21	13	26	9	29	2	33	1	25	6	86	91	29	50	41	141	33
51	21	43	20	65	3	50	3	75	--	--	168	54	38	32	206	47
28	15	31	2	6	1	17	--	--	1	14	53	17	33	37	86	20
	2.4		2.7**		6.3		4.0		1.5††		2.9		2.8		2.9	
78	126	81	2	14	3	15	5	50	34	81	201	63.3	347	67.9	548	66.1
22	30	19	12	86	17	85	5	50	8	19	117	36.7	164	32.1	281	33.9
(64)	156	(77)	14	(35)	20	(80)	10	(63)	42	(79)	318	(61)	511	(78)	829	(71)
88	29	62	14	87	4	57	22	96	3	33	235	93	87	63	322	82
1	4	8	--	--	--	--	--	--	1	11	2	1	8	6	10	3
5	2	4	--	--	--	--	--	--	2	23	6	2	7	5	13	3
6	12	26	2	13	3	43	1	4	3	33	10	4	36	26	46	12
91	23	79	11	79	2	67	19	86	2	67	204	87	68	78	272	84
1	20	9	1	5	6	22	--	--	3	5	29	6	76	11	105	9
8	43	21	5	25	12	45	1	4	15	26	91	17	179	27	270	23
91	146	70	14	70	9	33	24	96	40	69	398	77	413	62	811	68
(62)	209	(79)	20	(35)	27	(82)	25	(62)	58	(92)	518	(66)	668	(82)	1,186	(74)

C

Appendix E

DAMAGE BY USE, TYPE, ESTIMATED COST, AND BOOM AREA

Table E-1

DAMAGE BY USE, TYPE, ESTIMATED COST - PITTSB
(Denied Incidents - 623 Damage Inci

		Single Family (Includes Duplexes) (80% of all damage incidents)						Multifamily (5% of all damage incidents)			
	Total	% of Total	No. of Incidents	% of Total Category	Average Estimated Cost per Incident	No. of Surfaces Recorded	Average Estimated Cost per Surface	No. of Incidents	% of Total Category	Average Estimated Cost per Incident	No. of Surfaces Recorded
Total damage incidents	623	100%	495	100%	$267		$	31	100%	$307	
Total glass incidents	121	19	73	14	59	204	21	5	16	24	9
Less than 2 ft in least dimension	23	25	19	31	102	99	20	1	33	4	1
2 ft to 4 ft in least dimension	48	52	38	61	32	85	15	2	67	12	2
Greater than 4 ft in least dimension	22	23	5	8	162	5	162	--	--	--	
Damage type 1	22		14		108	38	40	--		--	
Damage type 2	33		20		65	58	22	1		4	1
Damage type 3	38		28		42	93	13	2		12	2
Damage type 4	28		11		31	15	23	2		44	6
Window glass	38		29					3			
Plate glass	26		4								
Thermopane glass	6		6								
Total plaster incidents	225	36	201	41	257			14	45	161	
Damage type 55	26		20		145			5		176	
Damage type 56	--		--		--			--		--	
Damage type 57	36		29		199			5		67	
Subtotal	62		49	24	177			10	71	101	
Damage type 65	9		9		306			--		--	
Damage type 66	10		9		176			--		--	
Damage type 67	57		51		228			1		585	
Subtotal	76		69	35	231			1	7	585	
Damage type 75	33		32		277			1		302	
Damage type 76	8		8		300			--		--	
Damage type 77	45		43		358			2		195	
Subtotal	86		83	41	326			3	22	248	
Fallen object incidents	25	4	20	4	90			1	3	25	
Type 88	3		2		160			--		--	
Type 89	22		18		82			1		25	
Other incidents ("90" series")	252	41	201	41	372			11	36	606	

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able E-1

ATED COST - PITTSBURGH BOOM AREA
s - 623 Damage Incidents)

Multifamily (% of all damage incidents)				Commercial (Retail/Office/Warehousing) (10% of all damage incidents)					Industrial (1% of all damage incidents)		Other and Unknown (4% of all damage incidents)	
of otal egory	Average Estimated Cost per Incident	No. of Surfaces Recorded	Average Estimated Cost per Surface	No. of Incidents	% of Total Category	Average Estimated Cost per Incident	No. of Surfaces Recorded	Average Estimated Cost per Surface	No. of Incidents	% of Total Category	No. of Incidents	% of Total Category
00%	$307		$	60	100%	$401		$	9	100%	28	100%
1C	24	9	13	27	45	249	40	168	3	33	13	46
33	4	1	4	1	4	25	2	12	2	66	--	
67	12	2	12	8	32	171	17	81	--	--	--	
-	--			16	64	300	18	267	1	33	--	
	--			8		61	10	49	--		--	
	4	1	4	12		398	21	227	--		--	
	2	2	12	5		188	6	156	3		--	
	44	6	15	2		270	3	180	--		13	
				4					2		--	
				21					1		--	
5	161			9	15	880			--	--	1	4
	176			1		83						
	--			--		--						
	67			2		678						
71	101			3	33	479					--	
	--			--		--					--	
	--			1		120					--	
	585			5		1,273					1	
7	585			6	67	1,080					1	
	302			--		--						
	--			--		--						
	195			--		--						
22	248			--	--	--					--	
3	25			2	3	84			1	11	1	4
	--			--		--			1		--	
	25			2		84			--		1	
36	606			22	37	420			5	56	13	46

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Table E-2

DAMAGE BY USE, TYPE, ESTIMATED COST - MIL
(Denied Incidents - 360 Damage Inc

	Total	Single Family (Includes Duplexes) (88% of all damage incidents) % of Total	No. of Incidents	% of Total Category	Average Estimated Cost per Incident	No. of Surfaces Recorded	Average Estimated Cost per Surface	Multif (4% of all dama No. of Incidents	% of Total Category	Avera Estima Cost Incide
Total damage incidents	360	100%	317	100%	$155		$	13	100%	$112
Total glass incidents	56	16	40	13	53	118	18	5	38	126
Less than 2 ft in least dimension	19		16	41	36	64	9	3	60	182
2 ft to 4 ft in least dimension	18		15	38	26	45	9	2	40	42
Greater than 4 ft in least dimension	14		8	21	141	8	141	--	--	
Damage type 1	9		6	15	39	10	24	2	40	248
Damage type 2	15		11	28	61	20	34	--	--	
Damage type 3	27		22	55	54	87	14	3	60	44
Damage type 4	5		1	2	23	1	23	--	--	
Window glass	24		20					4		
Plate glass	11		4					--		
Total plaster incidents	176	49	166	52	167			5	38	
Damage type 55	11		10		163			--		
Damage type 56	--		--		--			--		
Damage type 57	28		24		92			3		72
Subtotal	39		34	21	113			3	60	72
Damage type 65	12		12		108			--		
Damage type 66	13		11		175			1		150
Damage type 67	22		22		201			--		
Subtotal	47		45	27	170			1	20	150
Damage type 75	31		31		174			--		
Damage type 76	8		8		143			--		
Damage type 77	51		48		222			1		205
Subtotal	90		87	52	198			1	20	205
Total other incidents	128	35	111	35	165			3	23	88
Type 88	1		1	1	6			--		
Type 89	8		5	4	97			1	33	52
Type 90	119		105	95	170			2	67	105

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Table E-2

STIMATED COST - MILWAUKEE BOOM AREA
ts - 360 Damage Incidents)

Multifamily (4% of all damage incidents)					Commercial (Retail/Office/Warehousing) (5% of all damage incidents)					Other and Unknown (3% of all damage incidents)	
. of idents	% of Total Category	Average Estimated Cost per Incident	No. of Surfaces Recorded	Average Estimated Cost per Surface	No. of Incidents	% of Total Category	Average Estimated Cost per Incident	No. of Surfaces Recorded	Average Estimated Cost per Surface	No. of Incidents	% of Total Category
13	100%	$112			18	100%	$290		$	12	100%
5	38	126	44	$14	7	44	200	10	140	4	33
3	60	182	36	15	--	--				--	
2	40	42	8	10	1	14	52	1	52	--	
--	--				6	86	225	9	150	--	
2	40	248	26	19	1	14	52	1	52	--	
--	--				[illegible]	57	246	6	164	--	
3	60	44	18	7	2	29	183	3	122	--	
--	--									4	100
4					--					--	
--					7					--	
5	38				4	22	92			1	8
--					1		80			--	
--					--					--	
3		72			1		36			--	
3	60	72			2	50	58			--	
--					--					--	
1		150			1		150			--	
--					--					--	
1	20	150			1	25	150			--	
--					--		--			--	
--					--		--			--	
1		205			1		104			1	
1	20	205			1	25	104			1	100
3	23	88			7	44	491			7	58
--					--					--	
1	33	52			2		129			--	
2	67	105			5		636			7	100

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Table E-3

DAMAGE BY USE, TYPE, ESTIMATED COST - OKLAHOMA
(Denied Incidents - 454 Damage Incid

		Single Family (Includes Duplexes) (92% of all damage incidents)						Multifamil (2% of all damage i		
	Total	% of Total	No. of Incidents	% of Total Category	Average Estimated Cost per Incident	No. of Surfaces Recorded	Average Estimated Cost per Surface	No. of Incidents	% of Total Category	Average Estimated Cost per Incident
Total damage incidents	454	100%	451	100%	$208		$	8	100%	$343
Total glass incidents	47	11	35	8	16	84	7	2	25	12
Less than 2 ft in least dimension	25		20	62	15	57	5	2	100	12
2 ft to 4 ft in least dimension	12		12	38	18	23	10	--	--	--
Greater than 4 ft in least dimension	4		0	--	--	--	--	--	--	--
Damage type 1	18		16	46	19	41	7	--	--	--
Damage type 2	17		11	31	15	28	6	1	50	10
Damage type 3	6		5	14	13	10	6	1	50	15
Damage type 4	6		3	9	16	4	12	--	--	
Window glass	24		20					2		
Plate glass	5		1					--		
Total plaster incidents	255	56	245	59	277			4	50	560
Damage type 55	6		5							
Damage type 56	--		--							
Damage type 57	13		13							
Subtotal	19		18	7	153			--	--	
Damage type 65	2		2					--		
Damage type 66	1		1					--		
Damage type 67	33		32					1		
Subtotal	36		35	14	272			1	25	690
Damage type 75	44		44					--		
Damage type 76	28		27					--		
Damage type 77	128		121					3		
Subtotal	200		192	79	288			3	75	523
Fallen object incidents	6	1	6	2	59			--	--	
Type 88	1		1							
Type 89	5		5							
Other incidents ("90 & 91 series")	146	32	129	31	138			2	25	229
Type 90	(139)		122		136			2	100	229
Type 91	(7)		7		182					

* Represents approximately 10% sample of total denied incidents.

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Table E-3

ESTIMATED COST - OKLAHOMA CITY BOOM AREA
idents - 454 Damage Incidents*)

e ed er e	Multifamily (2% of all damage incidents)					Commercial (Retail/Office/Warehousing) (4% of all damage incidents)					Other and Unknown (2% of all damage incidents)	
	No. of Incidents	% of Total Category	Average Estimated Cost per Incident	No. of Surfaces Recorded	Average Estimated Cost per Surface	No. of Incidents	% of Total Category	Average Estimated Cost per Incident	No. of Surfaces Recorded	Average Estimated Cost per Surface	No. of Incidents	% of Total Category
	8	100%	$343		$	21	100%	$160		$	10	100%
	2	25	12	3	8	7	33	48	8	42	3	30
	2	100	12	3	8	3	43	23	4	18		
	--	--	--	--	--	--	--	--	--	--		
	--	--	--	--	--	4	57	67	4	67		
	--	--	--	--	--	2	29	61	3	41		
	1	50	10	2	5	5	71	43	5	43		
	1	50	15	1	15	--	--	--	--	--		
	--	--									3	100
	2					2						
	--					4						
	4	50	560			5	24	299			1	10
						1						
						--						
	—					--						
	--	--				1	20	115			--	
	--											
	--											
	1					—						
	1	25	690			--	--				--	
	--					--						
	--					1						
	3					3					1	
	3	75	523			4	80	344			1	100
	--	--				--	--				0	--
	2	25	229			9	43	168			6	60
	2	100	229			9	100	168			6	100

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Table E-4

DAMAGE BY USE, TYPE, ESTIMATED COST - ST.
(Paid Incidents - 221 Damage In

		Single Family (Includes Duplexes) (76% of all damage incidents)						(77% of a	
	Total	% of Total	No. of Incidents	% of Total Category	Average Estimated Cost per Incident	No. of Surfaces Recorded	Average Estimated Cost per Surface	No. of Incidents	% of Total Category*
Total damage incidents	221	100%	168	100%	$		$	16	100%
Total glass incidents	97	44	57	34	34	176	7	8	50
Less than 2 ft in least dimension	24		21	42	28	86	7	2	25
2 ft to 4 ft in least dimension	30		23	46	22	68	8	5	62
Greater than 4 ft in least dimension	36		6	12	87	12	43	1	13
Damage type 1	38		17	30	20	55	6	6	75
Damage type 2	40		25	44	43	70	15	1	13
Damage type 3	11		8	14	26	31	7	1	13
Damage type 4	7		7	12	46	7	46	0	--
Window glass	38		31					5	
Plate glass	36		4					2	
Noted as progressive	1		1					0	
Total plaster incidents	95	43	85	51	156			6	38
Damage type 55	21		15		104			4	
Damage type 56	0		0		--			--	
Damage type 57	1		1		12			--	
Subtotal	22		16	19	98			4	67
Damage type 65	37		35		155			0	
Damage type 66	6		6		93			0	
Damage type 67	2		2		44			0	--
Subtotal	45		43	51	141			0	
Damage type 75	25		23		238			2	
Damage type 76	3		3		160			0	
Damage type 77	0		0		--			0	
Subtotal	28		26	30	228			2	33
Aggravated plaster damage	83		73	86				6	100
Noted as progressive	8		8					0	
Total other incidents	29	14	26	15	68			2	13
Type 88	5		4	15	14			0	--
Type 89	11		9	35	32			2	100
Type 90	14		13	50	110			0	--

* 1965 overflights.

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Table E-4

TYPE, ESTIMATED COST - ST. LOUIS BOOM AREA*
d Incidents - 221 Damage Incidents)

	Multifamily (77% of all damage incidents)					Commercial (Retail/Office/Warehousing) (17% of all damage incidents)				
Average Estimated Cost per Surface	No. of Incidents	% of Total Category	Average Estimated Cost per Incident	No. of Surfaces Recorded	Average Estimated Cost per Surface	No. of Incidents	% of Total Category	Average Estimated Cost per Incident	No. of Surfaces Recorded	Average Estimated Cost per Surface
$	16	100%	$103		$	37	100%	$244		$
7	8	50	41	28	23	32	86	258	45	139
7	2	25	62	12	10	1	3	18	2	9
8	5	62	33	15	11	2	6	92	6	31
43	1	13	37	1	37	29	91	278	37	218
6	6	75	34	16	13	16	50	280	21	213
15	1	13	120	11	11	14	44	209	18	163
7	1	13	4	1	4	2	6	435	6	145
46	0	--	--	--	--	0	--	--	--	--
	5					2				
	2					30				
	0					0				
	6	38	180			4	11	169		
	4		185			2		138		
	--		--			0		--		
	--		--			0		--		
	4	67	185			2	50	138		
	0		--			2		200		
	0		--			0		--		
	0	--	--			0		--		
	0		--			2	50	200		
	2		170			0		--		
	0		--			0		--		
	0		--			0		--		
	2	33	170			0	--	--		
	6	100				4	100			
	0					0				
	2	13	120			1	3	70		
	0	--	--			0	--	--		
	2	100	120			0	--	--		
	0	--	--			1	100	70		

Table E-5

DAMAGE BY USE, TYPE, ESTIMATED COST - ST. LOU
(Denied Incidents - 268 Damage Incid

	Total	Single Family (Includes Duplexes) (.3% of all damage incidents) % of Total	No. of Incidents	% of Total Category	Average Estimated Cost per Incident	No. of Surfaces Recorded	Average Estimated Cost per Surface	Multifamily (4% of all damage incidents) No. of Incidents	% of Total Category	Average Estimated Cost per Incident	No. of Surfaces Recorded	Es Co S
Total damage incidents	268	100%	224	100%	$210		$	10	100%	$138		
Total glass incidents	35	13	23	10	48	41	28	1	10	4	1	
Less than 2 ft in least dimension	4		3	17	12	8	5	1	100	4	1	
2 ft to 4 ft in least dimension	13		11	61	23	24	11	--				
Greater than 4 ft in least dimension	11		4	22	138	4	138	--				
Damage type 1	10		4	17	12	10	5	1	100	4	1	
Damage type 2	9		6	26	34	16	13	--				
Damage type 3	9		8	35	72	10	58	--				
Damage type 4	7		5	22	49	5	49	--				
Window glass	13		12	52				1	100			
Plate glass	12		3					--				
Noted as progressive	1		--					--				
Total plaster incidents	132	49	124	55	183			5	50	173		
Damage type 55	4		4					--				
Damage type 56	1		1					--				
Damage type 57	14		9					4				
Subtotal	19		14	11	114			4	80	147		
Damage type 65	11		11					--				
Damage type 66	13		13					--				
Damage type 67	55		53					1				
Subtotal	79		77	62	204			1	20	280		
Damage type 75	4		4					--				
Damage type 76	4		4					--				
Damage type 77	25		25					--				
Subtotal	34		33	26	16[illegible]			0	--			
Aggravated plaster damage	19		19	15				--	--			
Noted as progressive	13		13					--				
Total other incidents	101	38	77	35	302			4	40	78		
Type 88	3		0	--	--			--				
Type 89	4		4	5	100			--				
Type 90	94		73	95	313			4	100	78		

* 1965 overflights.

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Table E-5

STIMATED COST - ST. LOUIS BOOM AREA*
nts - 268 Damage Incidents)

Multifamily (4% of all damage incidents)				Commercial (Retail/Office/Warehousing) (5% of all damage incidents)					Industrial (1% of all damage incidents)		Other and Unknown (7% of all damage incidents)	
% of Total Category	Average Estimated Cost per Incident	No. of Surfaces Recorded	Average Estimated Cost per Surface	No. of Incidents	% of Total Category	Average Estimated Cost per Incident	No. of Surfaces Recorded	Average Estimated Cost per Surface	No. of Incidents	% of Total Category	No. of Incidents	% of Total Category
100%	$138		$	13	100%	$109		$	2	100%	19	100%
10	4	1	4	8	62	100	8	100	0	--	3	16
100	4	1	4	--	--						--	
				1	12	60	1	60			1	100
				7	78	106	7	106			--	
100	4	1	4	4	50	72	4	72			1	[illegible]3
				3	38	127	3	127			--	
				1	12	31	1	131			--	
				--							2	67
100				--							--	
				8	100						1	
				1							--	
50	173			2	15	52			0	--	1	[illegible]
				--							--	
				--							--	
				1							--	
80	147			1	50	68					0	--
				--							--	
				--							--	
				--							1	
20	280			0	--						1	100
				--							--	
				--							--	
				1							--	
--				1	50	35					0	--
--				--								
				--								
40	78			3	23	170			2	100	15	79
				--					--		3	20
				--					--		--	--
100	78			3	100	170			2	100	12	80

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Appendix F

INTERIM TECHNICAL REPORT 2 (ABSTRACTED)

Appendix F

INTERIM TECHNICAL REPORT 2 (ABSTRACTED)

This appendix presents charts, graphs, tables, and general data contained in the Institute's Interim Technical Report 2, Report on Data Retrieval and Analysis of USAF Sonic Boom Claims Files, issued in July 1966. Excluded, however, are all data and conclusions that have been either updated or duplicated in the main body of the report issued here.

Approximately 9,000 damage claims resulting from the overflight programs in Oklahoma City, Chicago, Pittsburgh, and Milwaukee* were received and adjudicated by the Air Force; 2,399 of these claims were paid. The paid claims files were analyzed and yielded a body of engineering data that was compiled in key punch form for electronic data processing. We believe that the evaluated files are a representative sample of the damage types and building characteristics affected.

Methodology

During the earlier periods of the definition study, certain limited claims information was provided by means of the monthly USAF computer readout of damage claims for overflights at Oklahoma City, Chicago, Pittsburgh, and Milwaukee. Although this information served a necessary purpose for the Air Force, it did not depict an in-depth analysis of the actual nature of damage and the actual costs. A sampling of the files convinced the Institute team that such an analysis was highly possible if the reasons for, variations in, and background philosophies reflected by the file information were fully understood.

Because of the drawbacks of relying solely on data recorded in the claims files, the Institute also met with Air Force representatives to obtain further information. These sessions are briefly described below:

1. An intensive two-day briefing session was held with Major Robert L. Atwood/AFJALD. This session primarily covered variations

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* Oklahoma City boom area - February to July 1964; Chicago boom area - January to March 1965; Pittsburgh boom area - April to June 1965; Milwaukee boom area - July to September 1965.

and changes in policies and procedures among the four cities, as well as within single cities. The general types of investigators, evaluators, and engineers were also discussed.

2. For a 10-day period at the outset of the files review program, an Air Force representative with considerable knowledge of the claims files was assigned from General Higgins' office at Wright-Patterson Air Force Base to work closely with SRI personnel. Format, content, and applicability of information in the claims files were prime targets for interpretation.

In view of the foregoing, the Institute's approach was to disregard payment policy, per se, and certain human judgments, and concentrate on the actual nature and conditions of damage and their related costs.

In order to relate new, retrieved data to the original work of the USAF, a copy of the USAF monthly report in computer format (magnetic tape) was obtained. Correlation between the two sets of data was then possible, which was especially useful in compiling "date of incident" data.

Eleven basic questions were developed for the computer. Seventy responses, in key punch card format, were possible, which provided computer capability for producing multiquestioned outputs well into the hundreds. We believe that further use of the original files will not be necessary. Copies of representative photography were also extracted from the files for later use in plate vs racking evaluations, and as guidelines for future investigators.

Building Characteristics

To relate the types and characteristics of the structures subjected to sonic boom in the four test areas to the types and characteristics that prevail throughout the United States, the following information was obtained from the files:

Item	Remarks
Building address	For ultimate plotting on damage zone maps
Building owned or rented	To test for possible occupant patt. s and relate to U.S. Census base

Item	Remarks
Use of building	Single or multiple family, commercial/ office, and industrial
Type of building construction	Wood frame, masonry, concrete, steel frame, etc., each with subcategories
Age of building	To determine possible trends and construction material relationships, and to relate to FHA housing base data
Condition of building	Sound, fair, or dilapidated
Height of structure	Number of stories or floors
Floor(s) where damage occurred	Height above ground; dominant trends
Number of surfaces affected	Glass panes broken or plaster surfaces damaged
Actual cost of repair	Either bona fide contractor's estimate or paid invoice

Damage Characteristics

The foregoing information was generally extracted from recorded notations and did not require a great deal of personal judgment; however, the study of damage characteristics necessitated greater care in order to minimize human judgments made in the field and to prevent this potential weakness from overly affecting the output data. (Such factors as personnel training, staff turnover, payment policy, and staff capabilities and size affect the level of judgment.) Therefore, the original writings, sketches, and photographs prepared by the claim adjusters and inspectors were used as much as possible in order to be free of subsequent interpretations or conclusions. However, where the information was minimal, certain interpretive information was, of necessity, used.

At the outset, a certain number of the claims files had to be sampled in order to establish the extent and nature of possible damage types. A set of descriptors was derived from this sampling to account for all the types of damage. These types were so identified that key punch operations

could easily be performed. General descriptions and selected modifiers are listed below; damage descriptor codes are included in Appendix A.

1. Glass: by type of breakage or crack.
2. Glass: by type; e.g., plate, window, mirror.
3. Glass: by size; less than 2 feet wide, 2 feet to 4 feet, and greater than 4 feet wide.
4. Falling plaster: ceiling; aggravated or predamaged; new.
5. Plaster damage: wall and/or ceiling; type of cracking; aggravated or predamaged.
6. Plaster: by type; lath, plasterboard, drywall, acoustical tile.
7. Progressive damage: evidenced by extension of damage from two or more booms.
8. Falling objects: from loose condition.
9. Falling objects: from secured condition.
10. Miscellaneous objects: TV; fixtures; animals.
11. Multiple or single floor damage.

Results of Interim Evaluation

Figures F-1, F-2, and F-3 are illustrative only, and reflect Air Force experience in receiving damage complaints and claims. The number of complaints and claims received per week are plotted against the week of receipt. (Oklahoma City data for "week of filing" were not available.) Figure F-4 is a comparative plot of these separate curves. Although 80 percent of the complaints were registered during the period of sonic booms, only 50 percent of the total number of claimants actually filed a formal claim during the same period.

Tables F-1 and F-2 have been superceded (see text tables).

Tables F-3, F-4, F-5, F-6, and F-7 provide more detailed summaries, abstracted from computer printouts, of the various relationships between types of damage and costs. The size and number of glass panes damaged and

Figure F-1

CLAIMS FILING EXPERIENCE - Chicago Boom Area

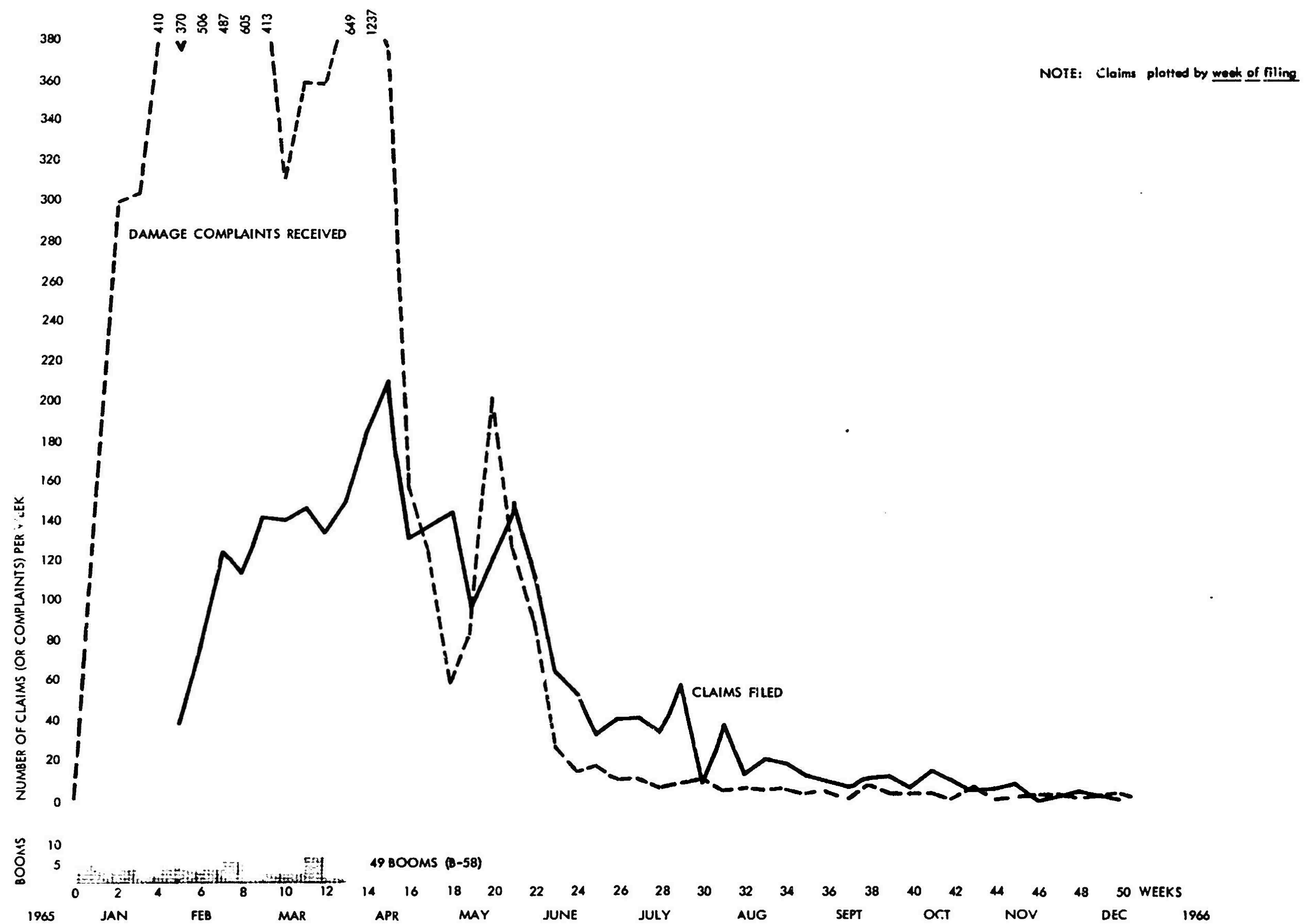


Figure F-2

CLAIMS FILING EXPERIENCE - Pittsburgh Boom Area

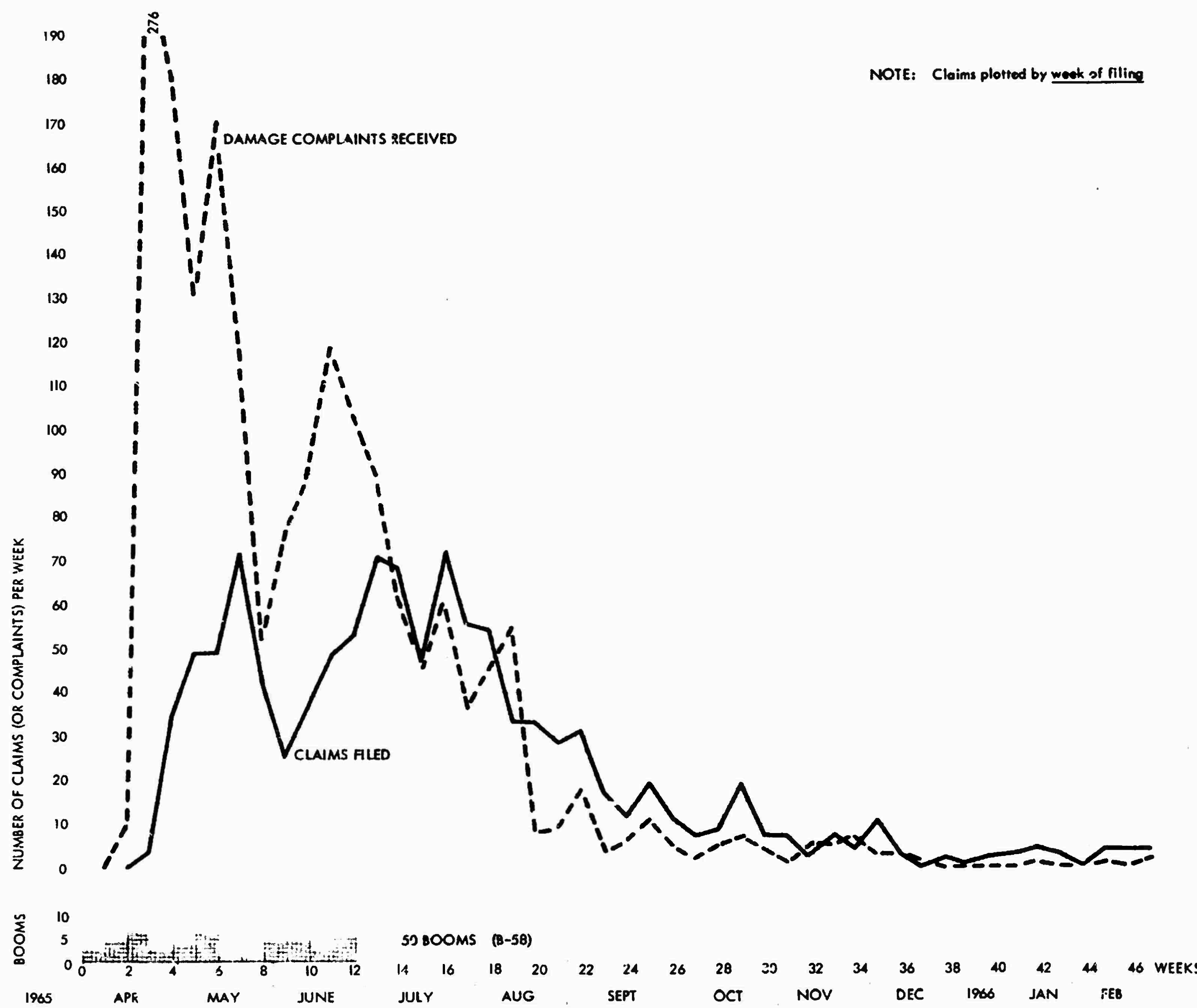


Figure F-3

CLAIMS FILING EXPERIENCE - Milwaukee Boom Area

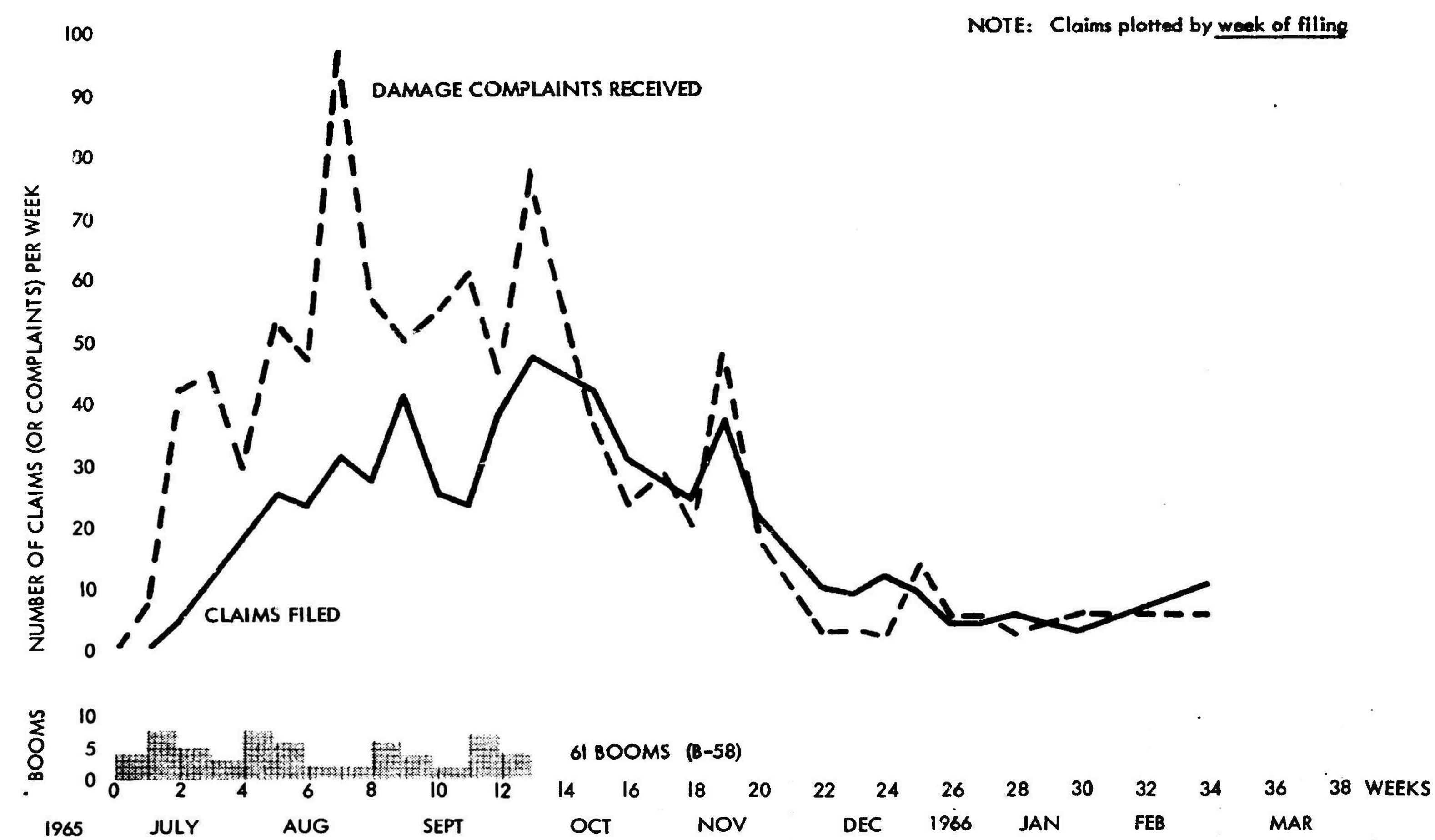
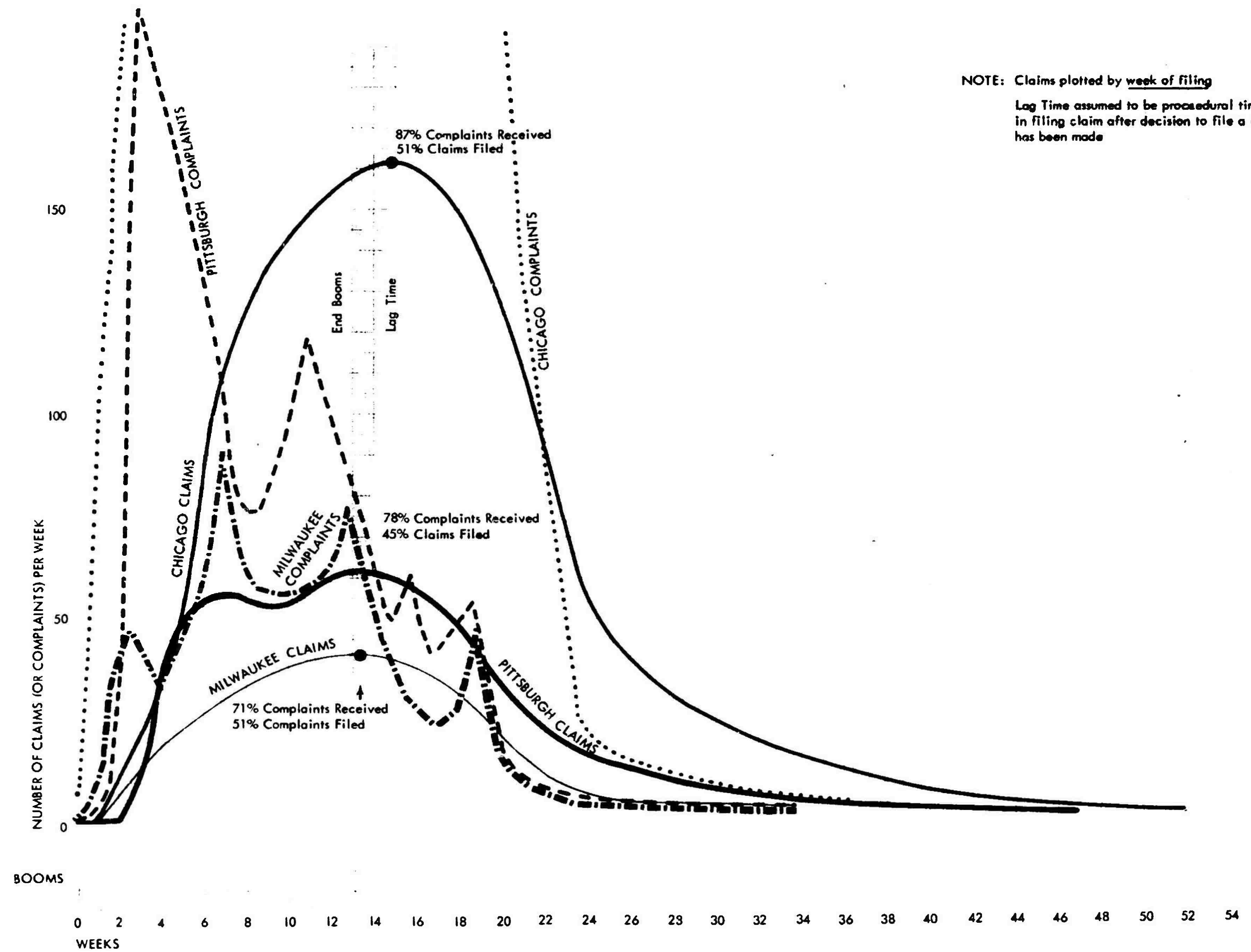


Figure F-4

CLAIMS FILING EXPERIENCE - Comparative Curves



NOTE: Claims plotted by <u>week of filing</u>

Lag Time assumed to be procedural time in filing claim after decision to file a claim has been made

Table F-1

GENERAL CLAIMS INFORMATION

SUPERSEDED
(See Text Table 1)

Table F-2

GENERAL DAMAGE COST INFORMATION
BY TYPE OF DAMAGE

SUPERSEDED
(See Text Table 32)

Table F-3

GENERAL DAMAGE COST INFORMATION
BY COST OF DAMAGE

	Award Amounts Paid									
	Less than $25		$25 to $100		$100 to $250		$250 to $500		$500 to $1,000	
Boom Area	Average Paid	Percent of Total	Average Paid	Percent of Total	Average Paid	Percent of Total	Average Paid	Percent of Total	Average Paid	Percent of Total
Chicago	$12	38%	$51	33%	$158	24%	$340	4%	$670	1%
Pittsburgh	13	49	51	31	158	15	310	4	640	1
Milwaukee	13	48	50	38	155	12	310	2	--	--
Oklahoma City	(comparable information was not available)									

Table F-4

DAMAGE BY USE, TYPE, ESTIMATED COST - CH
1455 Damage Incidents

		Single Family (Includes Duplexes) (60% of all damage incidents)					Mult (10% of all da		
	Total	No. of Claims	% of Total Category	Average Estimated Cost per Claim	No. of Surfaces Recorded	Average Estimated Cost per Surface	No. of Claims	% of Total Category	Avera Estima Cost Clai
Total damage incidents	1,455	876	100%	$ 59		$	141	100%	$ 6
Total glass incidents	1,094	585	67	36	1,075	13	98	69	3
Less than 2 ft in least dimension	181	152	26	13	365	5	16	16	
2 ft to 4 ft in least dimension	423	314	55	22	592	11	68	70	3
Greater than 4 ft in least dimension	469	108	19	115	148	79	14	14	7
Damage type 10	436	282	49	21	439	13	44	45	3
Damage type 20	501	[illegible]	38	46	462	22	40	41	5
Damage type 30	135	64	11	68	171	26	11	11	3
Damage type 40	19	13	2	41	*	*	3	3	2
Window glass	607	492					81		
Plate glass	397	25					9		
Noted as progressive	50	25					0		
Total plaster incidents	199	166	19	152			29	21	15
Damage type 55	25	21					2		
Damage type 56	8	5					3		
Damage type 57	1	1					--		
Subtotal	34	27	16	118			5	17	10
Damage type 65	85	72					12		
Damage type 66	28	24					4		
Damage type 67	13	10					2		
Subtotal	126	106	64	167			18	62	18
Damage type 75	28	24					4		
Damage type 76	9	7					2		
Damage type 77	1	1					0		
Subtotal	38	32	20	135			6	21	13
Aggravated plaster damage†	138	117	70				18	62	
Noted as progressive	11	10					1		
Total other incidents	162	124	14	43			14	10	8
Type 88	26	24	20	32			--	--	-
Type 89	63	50	40	46			10	71	6
Type 90	73	50	40	45			4	29	13

* Insufficient recorded information.
† Predamaged and/or pre-weakened plastic damage aggravated by sonic boom.

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Table F-4

TIMATED COST - CHICAGO BOOM AREA
amage Incidents

	Multifamily (10% of all damage incidents)				Commercial (Retail/Office/Warehousing) (29% of all damage incidents)					Industrial (< 1% of all damage incidents)	
of ns	% of Total Category	Average Estimated Cost per Claim	No. of Surfaces Recorded	Average Estimated Cost per Surface	No. of Claims	% of Total Category	Average Estimated Cost per Claim	No. of Surfaces Recorded	Average Estimated Cost per Surface	No. of Claims	% of Total Category
1	100%	$ 69		$	429	100%	$153		$	9	100%
8	69	39	320	12	402	93	157	590	107	9	100
6	16	9	26	6	10	3	167	77	22	3	33
8	70	39	275	10	38	10	86	105	31	3	33
1	14	70	13	68	344	87	170	408	143	3	33
4	45	31	157	87	108	22	167	198	91	2	22
0	41	50	120	16	231	57	152	308	114	6	67
1	11	32	37	10	59	14	168	82	121	1	11
3	3	26	6	18	3	7	33	*	*	0	--
1					32					2	
9					357					6	
0					25					0	
9	21	158			4	1	231			0	--
2					2					-	
3					--					-	
					--					-	
5	17	101			2	50	177			-	--
2					1					-	
4					--					-	
2					1					-	
8	62	189			2	50	285			-	--
4					--					-	
2					--					-	
0					--					-	
6	21	137			--	--	--			-	--
8	62				3	75				-	--
1					0					-	
4	10	87			24	6	59			0	--
-	--				2	8	62			-	--
0	71	6[illegible]			3	12	76			-	--
4	29	136			19	80	56			-	--

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Table F-5

DAMAGE BY USE, TYPE, ESTIMATED COST - PITTSBUR
502 Damage Incidents

		Single Family (Includes Duplexes) (73% of all damage incidents)						(7% of a	
	Total	No. of Claims	% of Total Category	Average Estimated Cost per Claim	No. of Surfaces Recorded	Average Estimated Cost per Surface	No. of Claims	% of Total Category
Total damage incidents	502	365	100%	$ 47		$	37	100%
Total glass incide..:s	355	241	66	24	497	11	24	67
Less than 2 ft in least dimension	68	59	25	18	215	5	2	8
2 ft to 4 ft in least dimension	177	150	65	23	280	12	18	75
Greater than 4 ft in least dimension	101	23	10	65	24	60	4	17
Damage type 10	161	121	49	16	209	9	13	56
Damage type 20	131	74	31	31	185	12	5	21
Damage type 30	47	30	13	31	98	9	6	25
Damage type 40	16	16	7	48	*	*	0	--
Window glass	236	202					21	
Plate glass	87	13					2	
Noted as progressive	9	5					--	
Total plaster incidents	60	55	15	141			4	11
Damage type 55	31	27					3	
Damage type 56	13	13					--	
Damage type 57	0	0					--	
Subtotal	43	40	73	116			3	75
Damage type 65	7	6					1	
Damage type 66	7	7					--	
Damage type 67	0	0					--	
Subtotal	14	13	24	199			1	25
Damage type 75	--	--					--	
Damage type 76	1	1					--	
Damage type 77	1	1					--	
Subtotal	2	2	3	267			--	
Aggravated plaster damage ‡	38	33	60				4	100
Noted as progressive	5	5					--	
Total other incidents	85	68	19	54			8	22
Type 88	18	15	22	33			1	12
Type 89	32	25	37	32			5	63
Type 90	35	28	41	86			2	25

* Insufficient recorded information.
† Unrealistic--one claim for $648 for damage to 300 glass panes in a greenhouse.
‡ Predamaged and/or pre-weakened plastic damage aggravated by sonic boom.

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Table F-5

TIMATED COST - PITTSBURGH BOOM AREA
Damage Incidents

	Multifamily (7% of all damage incidents)					Commercial (Retail/Office/Warehousing) (20% of all damage incidents)				
erage imated st per rface	No. of Claims	% of Total Category	Average Estimated Cost per Claim	No. of Surfaces Recorded	Average Estimated Cost per Surface	No. of Claims	% of Total Category	Average Estimated Cost per Claim	No. of Surfaces Recorded	Average Estimated Cost per Surface
$	37	100%	$ 48		$	100	100%	$152		$
11	24	67	32	48	15	90	90	162	415	35
5	2	8	*	*	*	7	8	137†	317	3
12	18	75	34	41	14	9	10	33	14	21
60	4	17	37	4	37	74	82	176	83	165
9	13	56	22	22	12	27	30	135	328	11
12	5	21	54	11	23	52	58	171	67	132
9	6	25	34	15	12	11	12	179	20	89
*	0	--	--	--	--	0	--	--	--	--
	21					13				
	2					72				
	--					4				
	4	11	212	--		1	1	55		
	3					1				
	--					--				
	--					--				
	3	75	102	--		1	100	55		
	1					--				
	--					--				
	--					--				
	1	25	545			--				
	--					--				
	--					--				
	--					--				
	--					--				
	4	100				1	100			
	--					--				
	8	22	22			9	9	62		
	1	12	30			2	22	24		
	5	63	19			2	22	96		
	2	25	24			5	56	64		

Table F-6

DAMAGE BY USE, TYPE, ESTIMATED COST - MILWAU
247 Damage Incidents

		Single Family (Includes Duplexes) (85% of all damage incidents)					(5% of a	
	Total	No. of Claims	% of Total Category	Average Estimated Cost per Claim	No. of Surfaces Recorded	Average Estimated Cost per Surface	No. of Claims	% of Total Category
Total damage incidents	246	208	100%	$ 81		$	11	100%
Total glass incidents	116	83	40	25	159	13	7	64
Less than 2 ft in least dimension	25	22	29	11	49	5	3	50
2 ft to 4 ft in least dimension	56	48	63	16	95	8	3	50
Greater than 4 ft in least dimension	27	6	8	107*	6	107*	0	--
Damage type 10	26	20	24	13	41	6	2	29
Damage type 20	55	34	41	31	61	18	3	43
Damage type 30	25	20	24	28	45	12	1	14
Damage type 40	10	9	11	37	3	8	1	14
Window glass	72	61					6	
Plate glass	24	7					--	
Noted as progressive	3	2					--	
Total plaster incidents	78	76	36	175			2	18
Damage type 55	17	17					--	
Damage type 56	0	0					--	
Damage type 57	1	1					--	
Subtotal	18	18	24	74			0	
Damage type 65	40	38					2	
Damage type 66	6	6					--	
Damage type 67	4	4					--	
Subtotal	50	48	63	195			2	100
Damage type 75	8	8					--	
Damage type 76	0	0					--	
Damage type 77	2	2					--	
Subtotal	10	10	13	252			0	
Aggravated plaster damage‡	67	63	83				2	100
Noted as progressive	*	*					--	
Total other incidents	52	49	24	28			2	18
Type 88	19	18	37	16			1	50
Type 89	14	13	26	34			1	50
Type 90	19	18	37	37			0	

* Unrealistic--one claim for $245 is included.
† Includes greenhouse with 18 panes damaged.
‡ Predamaged and/or pre-weakened plastic damage aggravated by sonic boom.

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Table F-6

STIMATED COST - MILWAUKEE BOOM AREA
Damage Incidents

	Multifamily (5% of all damage incidents)					Commercial (Retail/Office/Warehousing) (10% of all damage incidents)				
rage mated t per face	No. of Claims	% of Total Category	Average Estimated Cost per Claim	No. of Surfaces Recorded	Average Estimated Cost per Surface	No. of Claims	% of Total Category	Average Estimated Cost per Claim	No. of Surfaces Recorded	Average Estimated Cost per Surface
	11	100%	$ 43		$	27	100%	$147		$
13	7	64	21	8	12	26	96	137	45	82
5	3	50	11	4	8	0	--	--	--	--
8	3	50	20	4	15	5	27	81	23	18
107*	0	--	--	--	--	21	73	150	23	137
6	2	29	8	2	8	4	15	150	5	120
18	3	43	2[illegible]	5	15	18	70	140	36†	70
12	1	14	5	1	5	4	15	115	4	115
8	1	14	57	-	--	0	--	--	--	--
	6					5				
	--					17				
	--					1				
	2	18	109			--	--	--		
	--					--				
	--					--				
	--					--				
	0					0				
	2					--				
	--					--				
	--					--				
	2	100	109			--	--	--		
	--					--				
	--					--				
	--					--				
	0					0				
	2	100				--	--	--		
	--					--				
	2	18	50			1	4	399		
	1	50	85			0	--	--		
	1	50	16			0	--	--		
	0					1	100	399		

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Table F-7

DAMAGE BY USE, TYPE, ESTIMATED COST - OKI

281 Damage Incidents

	Total	Single Family (Includes Duplexes) (82% of all damage incidents)					(3% o	
		No. of Claims	% of Total Category	Average Estimated Cost per Claim	No. of Surfaces Recorded	Average Estimated Cost per Surface	No. of Claims	% of Total Categor
Total damage incidents	277	227	100%	$ 91		$	7	100%
Total glass incidents	107	71	31	16	113	10	1	14
Less than 2 ft in least dimension	16	14	21	9	20	6	--	--
2 ft to 4 ft in least dimension	52	48	72	12	85	7	1	100
Greater than 4 ft in least dimension	35	5	7	49	7	35	--	--
Damage type 10	43	33	46	9	57	5	1	100
Damage type 20	49	29	41	21	47	13	--	--
Damage type 30	11	5	7	11	8	6	--	--
Damage type 40	4	4	6	33	1	28	--	--
Window glass	66	60					1	
Plate glass	33	4					--	
Noted as progressive	2	2					--	
Total plaster incidents	124	119	52	154			4	57
Damage type 55	14	12					2	
Damage type 56	--	--					--	
Damage type 57	3	2					1	
Subtotal	17	14	12	108			3	75
Damage type 65	50	49					1	
Damage type 66	12	12					--	
Damage type 67	9	9					--	
Subtotal	71	70	58	167			1	25
Damage type 75	27	26					--	
Damage type 76	7	7					--	
Damage type 77	2	2					--	
Subtotal	36	35	30	149			--	
Aggravated plaster damage †	92	88	74				3	75
Noted as progressive	1	1					--	
Total other incidents	47	38	17	133			2	29
Type 88	11	10	26	37			--	--
Type 89	20	18	48	28			1	50
Type 90	16	10	26	36			1	50

* Unrealistic--includes church window claim for $890.00.

† Predamaged and/or pre-weakened plastic damage aggravated by sonic boom.

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Table F-7

ESTIMATED COST - OKLAHOMA CITY BOOM AREA
281 Damage Incidents

	Multifamily (3% of all damage incidents)					Commercial (Retail/Office/Warehousing) (15% of all damage incidents)				
rage mated t per face	No. of Claims	% of Total Category	Average Estimated Cost per Claim	No. of Surfaces Recorded	Average Estimated Cost per Surface	No. of Claims	% of Total Category	Average Estimated Cost per Claim	No. of Surfaces Recorded	Average Estimated Cost per Surface
	7	100%	$ 86		$	43	100%	$121		$
10	1	14	16	1	16	35	82	117	49	83
6	--	--	--	-	--	2	7	33	8	4
7	1	100	16	1	16	3	10	15	3	15
35	--	--	--	-	--	30	83	134*	38	105
5	1	100	16	1	16	9	26	74	10	63
13	--	--	--	-	--	20	57	96	28	69
6	--	--	--	-	--	6	17	250*	11	136
28	--	--	--	-	--	--	--	--	--	--
	1					5				
	--					29				
	--					--				
	4	57	108			1	2	255		
	2					--				
	--					--				
	1					--				
	3	75	105			--				
	1					--				
	--					--				
	--					--				
	1	25	120			--				
	--					1				
	--					--				
	--					--				
	--					1	100	255		
	3	75				1	100			
	--									
	2	29	76			7	16	123		
	--	--	--			1	14	27		
	1	50	2			1	14	192		
	1	50	150			5	72	128		

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the average estimated cost per pane is noted. In instances where a claims investigator provided such information, the number of incidents of progressive damage caused by two or more sonic booms are also indicated. The type of glass (window or plate) was taken from notations found in the file documents; however, care should be taken in utilizing these figures because of the inherent difficulty of inspectors evaluating various glass strengths. Even on contractors' estimate sheets or paid invoices, the replacement glass specified may not necessarily indicate the type of glass that was damaged. In the few cases where "extra strength" window glass was noted, this type was included in the window category.

Comparisons are made in Table F-8 among the various damage descriptors. The percentage occurrence in each classification follows relatively consistent trends in all four boom areas, except in the case of plaster in Pittsburgh, where the trend was reversed. This difference was caused by a predominance of falling ceiling plaster claims, probably due in part to the older homes in the Pittsburgh area (see Table F-10, "Use Versus Age").

The condition of the structure where the damage occurred was noted in 54 percent of the damage incidents reviewed. Table F-9 and Figure F-5 indicate the results in the three categories used:

1. Dilapidated: extensive deterioration, rundown condition.

2. Fair: moderate deterioration, in need of some repair.

3. Sound: little or no deterioration, well maintained.

Tables F-10 and F-11, and Figures F-6, F-7, and F-8 relate the number of damage incidents to the age of structures and to their height. Tables F-12, F-13, F-14, and F-15 and corresponding Figures F-9, F-10, F-11, and F-12 provide more detail as to building characteristics and age related to damage incidents. For single family homes, a percentage comparison is made between damaged homes and the Federal Housing Administration (FHA) insured home count of all homes in similar construction categories. The FHA base information was taken from <u>FHA-Homes 1964</u>, Division of Research and Statistics.

Table F-8

PLATE VERSUS RACKING FAILURES

Descriptors*	CBA Recorded Claims	CBA %	MBA Recorded Claims	MBA %	PBA Recorded Claims	PBA %	OBA Recorded Claims	OBA %	Remarks
Glass									
Type 20	501	79%	55	69%	131	73%	49	82%	Defined as plate failure mode
Type 30	135	21	25	31	47	27	11	18	Defined as racking failure mode even though wall surface at 90° to the racked surface may be plate loaded
Subtotal	636		80		178		60		
Plaster									
Type 50	34	17	18	23	43	73	17	15	Defined as predominantly racking failure mode
Type 60	126	64	50	64	14	24	71	56	Defined as plate failure mode
Type 70	38	19	10	13	2	3	36	29	Defined as racking failure mode even though wall or ceiling surface at 90° to racked surface may be plate loaded
Subtotal	198		78		59		124		

Note: (1) The predominant failure mode for glass is plate. Racking accounts for less than one-third of the glass failures.

(2) Plate is the predominant failure mode in all damaged surfaces except Pittsburgh where excesssive falling plaster caused a reverse trend.

* See Appendix A for definition and sketch of descriptors. All 10, 40, 80, and 90 descriptors not shown for above comparison.

Table F-9

CONDITION VERSUS USE

Boom Area	Condition*	Use: Single	Multiple	Commercial	Industrial	Total Recorded Claims
Chicago	DD	20	--	12	2	34
	FR	169	21	47	--	237
	SN	180	23	51	--	254
Pittsburgh	DD	21	4	4	--	29
	FR	143	8	31	--	182
	SN	90	--	19	--	109
Milwaukee	DD	4	--	--	--	4
	FR	127	4	11	--	142
	SN	58	1	6	--	65
Oklahoma City	DD	22	2	3	--	27
	FR	117	2	22	--	141
	SN	66	1	11	--	78
Total of claims with recorded condition						1,302 (54% sample)

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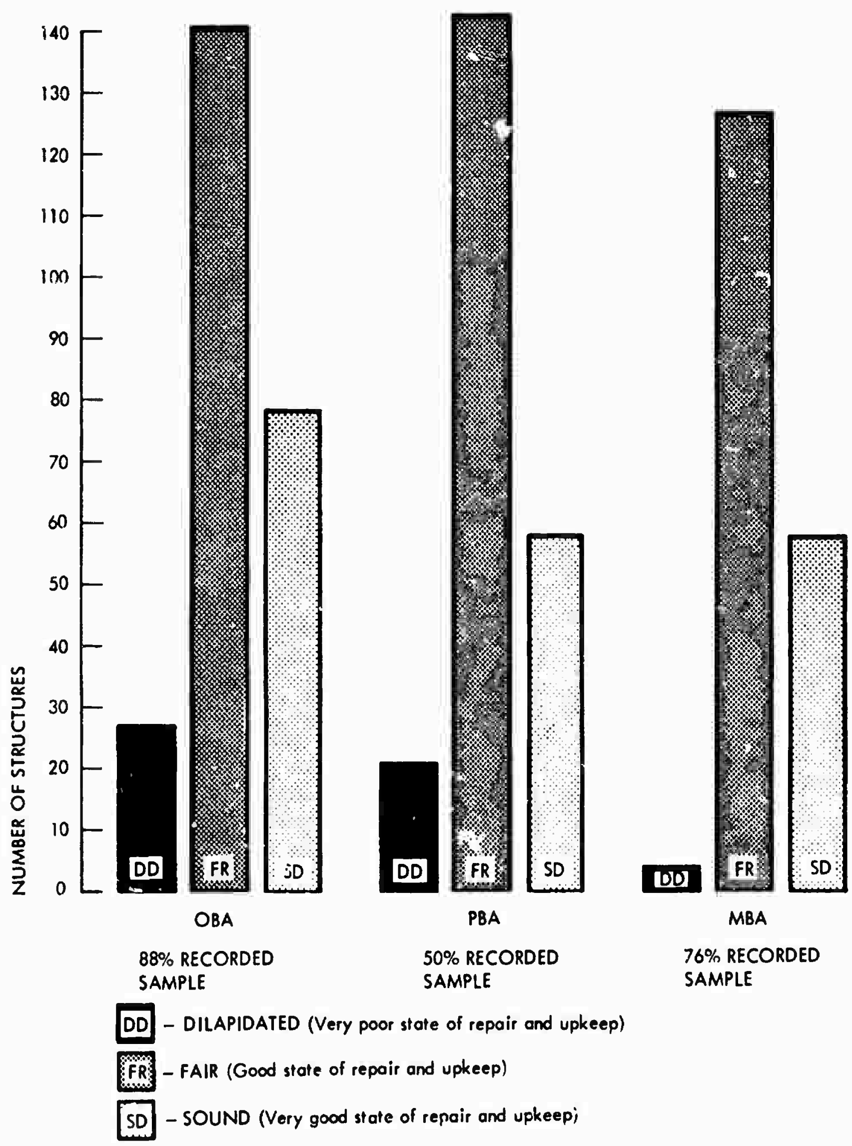
* DD = Dilapidated (extensive deterioration; run down condition)
FR = Fair (moderate deterioration; in need of some repair)
SD = Sound (little or no deterioration; well maintained)

Figure F-5

CONDITION OF DAMAGED STRUCTURES



Information on condition of structures damaged in Chicago and vicinity was sketchy and only noted on 369 of 1457 claims and was therefore not considered for the purpose of this chart. The 369 damaged structures were noted in the claims file as 20, 169, and 180 for DD, FR, and SD respectively.

Table F-10

USE VERSUS AGE

Boom Area	Use*	Total No. of Claims	1929 or Earlier	1930-1939	1940-1949	1950-1959	1960 or Later	Total
Chicago	S	594	208	74	59	177	76	
	M	112	50	28	1	20	13	
	C	339	187	64	25	37	26	
	I	8	4	1	1	1	1	
Subtotal		1,053						1,053
Pittsburgh	S	194	92	28	20	37	13	
	M	13	13	--	--	--	--	
	C	58	31	6	7	9	5	
	I	--	--	--	--	--	--	
Subtotal		265						265
Milwaukee	S	173	76	15	25	40	17	
	M	6	1	2	--	1	2	
	C	20	12	--	1	3	4	
	I	--	--	--	--	--	--	
Subtotal		199						199
Oklahoma City	S	216	46	42	44	51	33	
	M	6	4	1	--	1	--	
	C	40	3	6	7	15	9	
	I	--	--	--	--	--	--	
Subtotal		262						262
Total of claims with age recorded								1,779 (72% sample)

* S = single
M = multiple
C = commercial
I = industrial

Table F-11

HEIGHT VERSUS OWNERSHIP

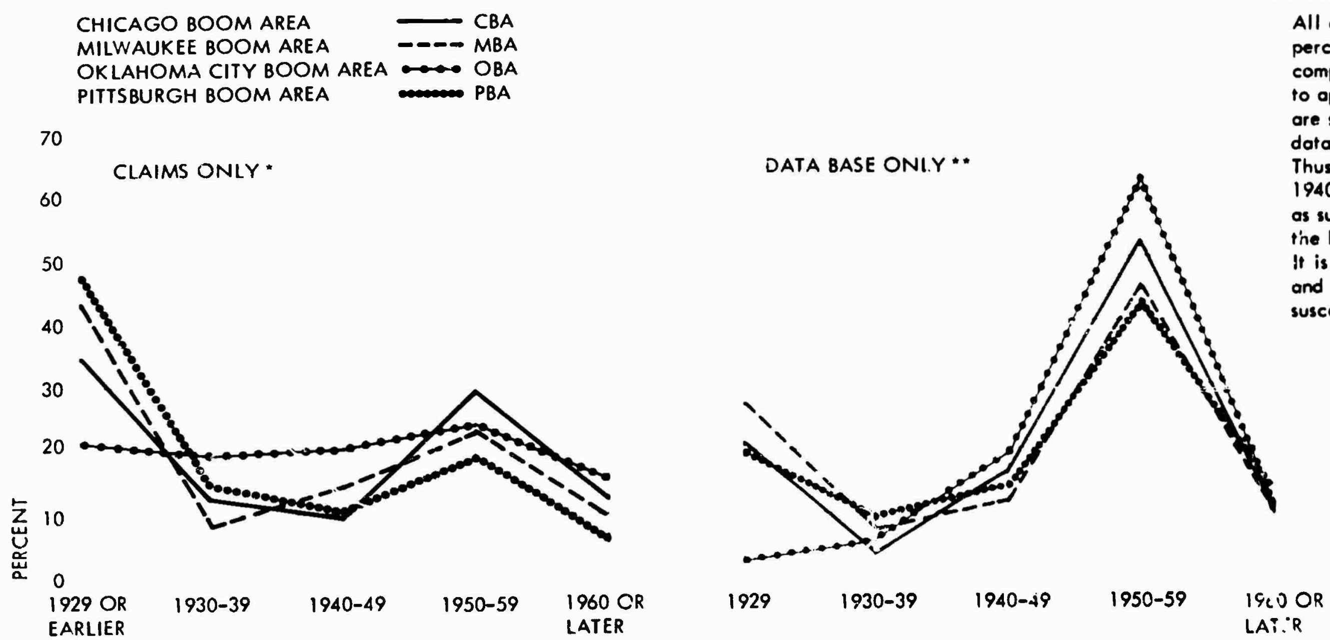
Height	Chicago O	Chicago L	Chicago M	Pittsburgh O	Pittsburgh L	Pittsburgh M	Milwaukee O	Milwaukee L	Milwaukee M	Oklahoma City O	Oklahoma City L	Oklahoma City M	Total O	Total L	Total M
1	399	58	1	85	10	-	52	8	-	195	28		731	104	1
2	362	116	4	125	32	-	83	27	1	28	11		598	186	5
3	73	73		34	27	-	4	1	0	1	2		112	103	-
4	7	6		-	2	-	1						8	8	-
5	2	6		-	-	-							2	6	-
6	-	5		-	-	1							-	5	1
7	2	1		-	1								2	2	
8	-	3		-	-								-	3	
9	-	-		-	1								-	1	
10	1	-		-									1	-	
11	-	-		-									-	-	
12	-	-		-									-	-	
13	-	1		-									-	1	
14	-	2		-									-	2	
15	2	2		-									-	4	
16	-	1		-									-	1	
17	1	-		·									1	-	
18	1	1		-									1	1	
19	-	1		-									-	1	
20	-	1		-									-	1	
26	-	2		-									-	2	
32	-	1		-									-	1	
40	1			-									1	-	
55				1										1	
Total	851	280	5	245	73	1	140	36	1	224	41	0	1,457	433	7

Total claims with height recorded 1,897 (75% sample)

Note: O = owner
L = lessee
M = other

Figure F-6

CLAIMS VERSUS DATA BASE
Single Family Dwellings (All Areas Compared)



SINGLE FAMILY DWELLINGS

All claims are much higher in percent to total claims when compared to the data base prior to approx. 1940. All claims are substantially less than the data base after that decade. Thus all homes built prior to the 1940-49 period are approx. twice as susceptible to damage as are the homes built after this decade. It is noted that the ratio reverses and the new homes are half as susceptible when so compared.

* Percentage computed as number of claims paid in any one city and vicinity for damage to single family dwellings during any decade when compared to all claims paid during entire time frame.

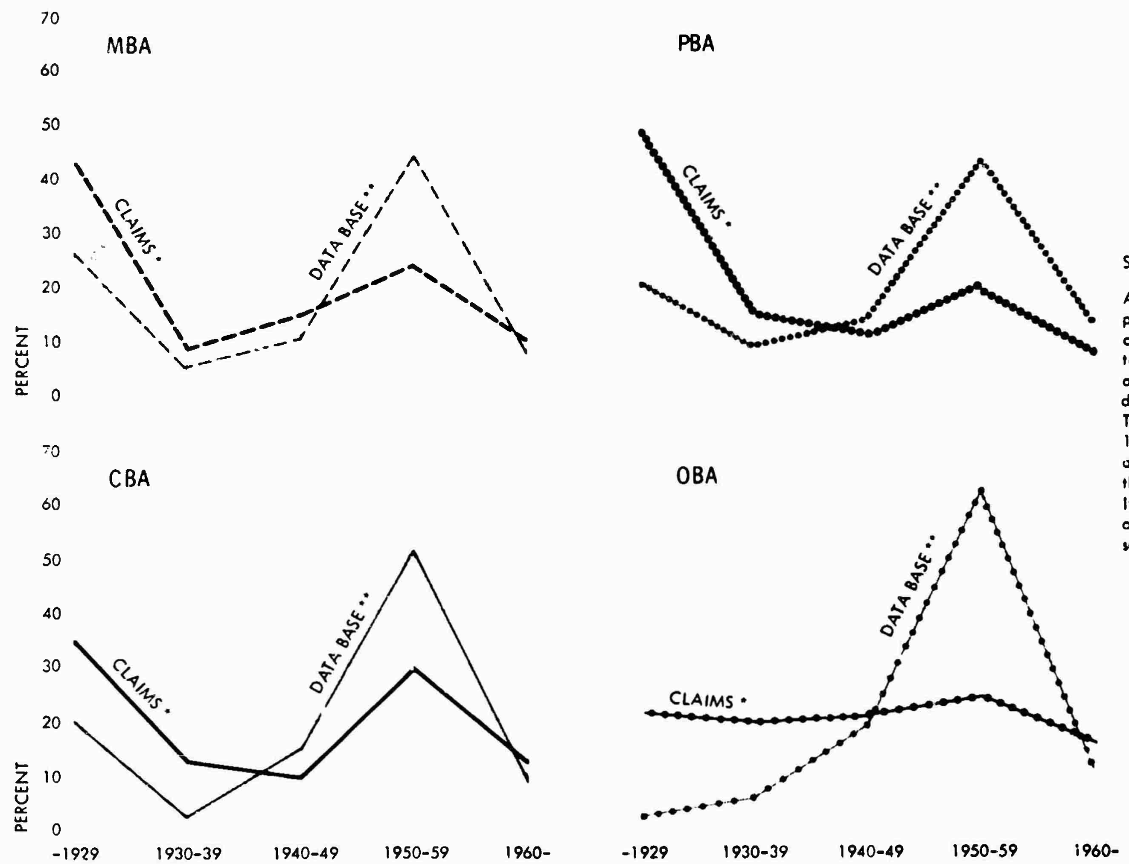
** Data base provides percentage of single family dwellings in any one city and vicinity which were exposed to sonic booms with age group dwelling defined by decade.

NOTE: Claims by percent are approximately equal for each decade but are considerably higher than the base prior to 1940-49; claims are much less than the base after this decade.

SOURCE FOR DATA BASE: Table 26M - FHA Division of Research & Statistics 1964.

Figure F-7

CLAIMS VERSUS DATA BASE
Single Family Dwellings (Comparisons By Area)



SINGLE FAMILY DWELLING

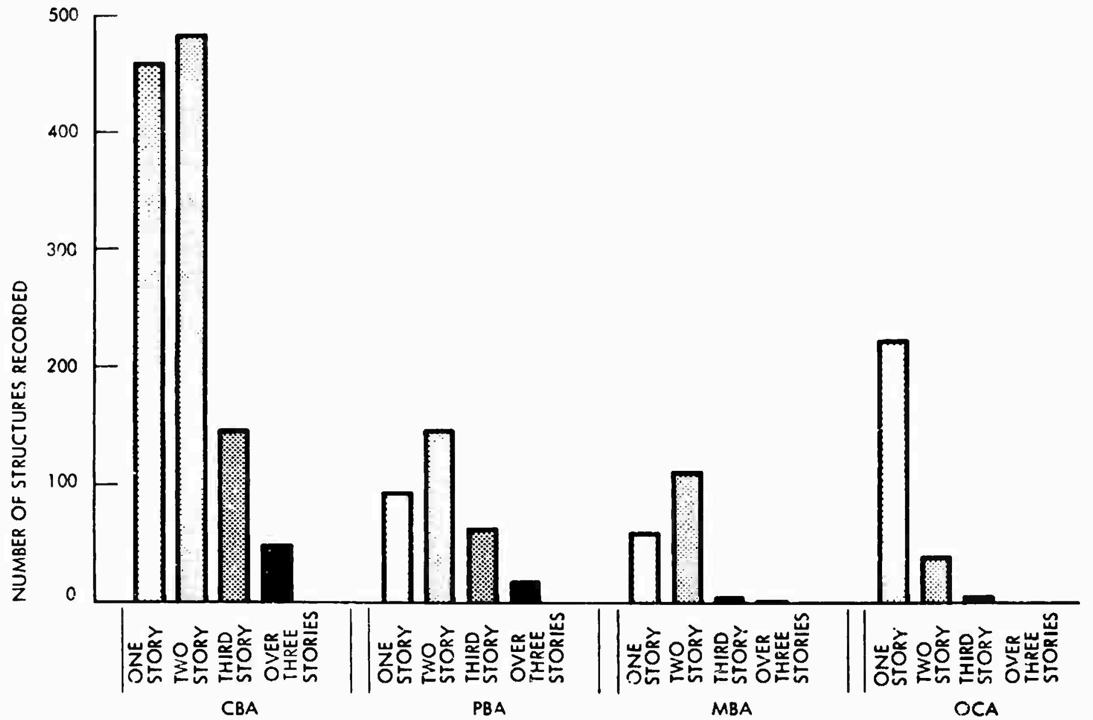
All claims are much higher in percent to total claims when compared to the data base prior to approx. 1940. All claims are substantially less than the data base after that decade. Thus all homes built prior to the 1940-49 period are approx. twice as susceptible to damage as are the homes built after this decade. It is noted that the ratio reverses and the new homes are half as susceptible when so compared.

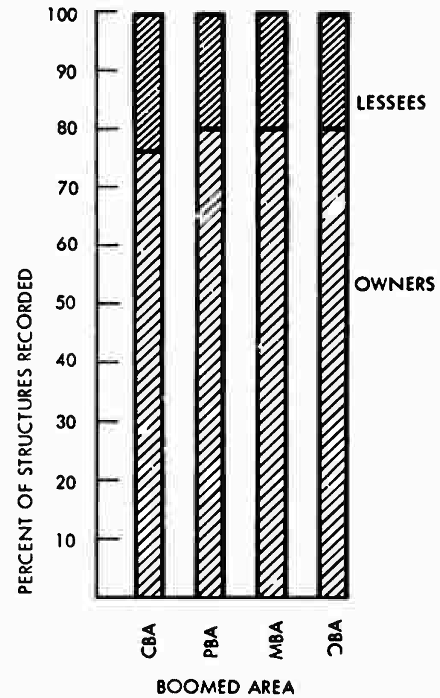
* Percentage computed as number of claims paid in any one city and vicinity for damage to single family dwellings during any decade when compared to all claims paid during entire time frame.
** Data base provides percentage of single family dwellings in any one city and vicinity which were exposed to damage with age group of dwelling as fined by decade.

SOURCE FOR DATA BASE: Table 26M - FHA Division of Research & Statistics 1964.

Figure F-8

HEIGHT OF STRUCTURES, COMPLAINTS BY OWNERS





NOTE:

1. Includes all S, M, C, and I reported.
2. Percentage given in recorded sample of total paid claims.

Table F-12

STRUCTURAL CHARACTERISTICS VERSUS AGE AND USE - CHICAGO BOOM AREA

	Use											
	Single Family						Multiple Family		Commercial		Industrial	
	1959 or Earlier			1960 or Later			1959 or Earlier	1960 or Later	1959 or Earlier	1960 or Later	1959 or Earlier	1960 or Later
	Claims		FHA Base	Claims		FHA Base						
Characteristics	Number	%	%	Number	%	%	Number	Number	Number	Number	Number	Number
Frame												
Wood, wood siding (W,WS)	129	26.2%	21.8%	4	5.5%	4.7%	3	-	19	1	-	-
Wood shingle (WH)	3	0.7	5.2	--		--	--	-	--	--	-	-
Asbestos shingle (AS)	3	0.7	2.9	--		--	--	-	--	--	-	-
Fiberboard (FB)	--	--	1.4	--		7.4	--	-	--	--	-	-
Brick or stone veneer (BS)	177	36.0	5.5	64	87.7	6.9	12	5	36	13	-	1
Stucco or concrete block (SC)	9	1.9	0.5	--		0.3	--	-		1	-	-
Combination (FF)	3	0.6	15.2	2	2.7	35.5	2	..				
Other (OF)	--	--	3.4	--		44.1	--	-				
Masonry												
Brick or stone (B,MB,M)	161	33.0	39.0	2	2.7	1.1	75	6	224	5	6	-
Stucco or concrete block (MC)	1	0.2	0.4	--		--	--	-	6	2	-	-
Combination (MM)	2	0.0	2.1	1	1.4	--	--	-	6	--	-	-
Other (CC,OM)	--	0.0	--	--		--	3	1	13	3	1	-
Frame-Masonry												
Combination (FM)	3	0.7	2.6	--		--	1	-	3	--	-	-
		100. %	100 %		100 %	100 %						
Steel												
Light frame (SL)	--	--	--	--	--	--	--	-	2	--	-	-

Note: Source for FHA Base taken from "FHA Homes--1964."

Table F-13

STRUCTURAL CHARACTERISTICS VERSUS AGE AND USE - PITTSBURGH BOOM AREA

Characteristics	Single Family: 1959 or Earlier: Claims: Number	Single Family: 1959 or Earlier: Claims: %	Single Family: 1959 or Earlier: FHA Base: %	Single Family: 1960 or Later: Claims: Number	Single Family: 1960 or Later: Claims: %	Single Family: 1960 or Later: FHA Base: %	Multiple Family: 1959 or Earlier: Number	Multiple Family: 1960 or Later: Number	Commercial: 1959 or Earlier: Number	Commercial: 1960 or Later: Number
Frame										
Wood, wood siding (W,WS)	52	29.5%	11.8%	-	%	4.5%	--		1	-
Wood shingle (WH)	6	3.4	2.0	-		0.3	--		--	-
Asbestos shingle (AS)	--	--	2.5	-		1.8	--		--	-
Fiberboard (FB)	1	0.5	0.4	-		0.6	--		--	-
Brick or stone veneer (BS)	44	25.0	59.2	9	82.0	33.3	--		6	3
Stucco or concrete block (SC)	1	0.6	0.8	-		--	--		1	-
Combination (FF)	4	2.2	14.9	1	9.0	49.3	--		--	-
Other (OF)	7	4.0	6.4	1	9.0	10.2	--		1	-
Masonry										
Brick or stone (B,MB,M)	55	31.2	1.3	-		--	10		31	1
Stucco or concrete block (MC)	--	--	0.3	-		--	--		7	1
Combination (MM)	1	0.6	0.3	-		--	--		2	-
Other (CC,OM)	2	1.2	--	-		--	--		3	-
Frame-Masonry										
Combination (FM)	3	1.8	0.1	-		--	2		--	-
		100 %	100 %		100 %	100 %				
Steel										
Light frame (SL)	--	--	--	-	--	--	--		--	-

Note: Source for FHA Base taken from "FHA Homes--1964."

Table F-14

STRUCTURAL CHARACTERISTICS VERSUS AGE AND USE - MILWAUKEE BOOM AREA

Characteristics	Use									
	Single Family						Multiple Family		Commercial	
	1959 or Earlier			1960 or Later			1959 or Earlier	1960 or Later	1959 or Earlier	1960 or Later
	Claims		FHA Base	Claims		FHA Base				
	Number	%	%	Number	%	%	Number	Number	Number	Number
Frame										
Wood, wood siding (W,WS)	74	50.0%	33.0%	3	25.0%	6.9%	-	-	-	-
Wood shingle (WH)	3	2.0	4.3	-		--	-	-	-	-
Asbestos shingle (AS)	1	0.6	10.3	-		22.4	-	-	-	-
Fiberboard (FB)	--	0.0	3.5	-		10.3	-	-	-	-
Brick or stone veneer (BS)	29	19.8	11.8	7	58.3	5.2	1	2	1	2
Stucco or concrete block (SC)	4	3.6	1.8	2	16.7	--	1	-	1	
Combination (FF)	1	0.6	15.2	-		4.3	-	-	-	-
Other (OF)	2	1.3	17.2	-		12.1	-	-	-	-
Masonry										
Brick or stone (B,MB,M)	16	11.0	0.5	-		--	1	-	9	-
Stucco or concrete block (MC)	3	2.0	1.8	-		--	-	-	1	1
Combination (MM)	2	1.3	0.2	-		--	-	-	-	-
Other (CC,OM)	1	0.6	0.2	-		--	-	-	-	-
Frame-Masonry										
Combination (FM)	11	7.4	0.1	-		--	-	-	1	-
		100 %	100 %		100 %	100 %				
Steel										
Light frame (SL)	--	--	--	-	--	--	-	-	-	-

Note: Source for FHA Base taken from "FHA Homes--1964."

Table F-15

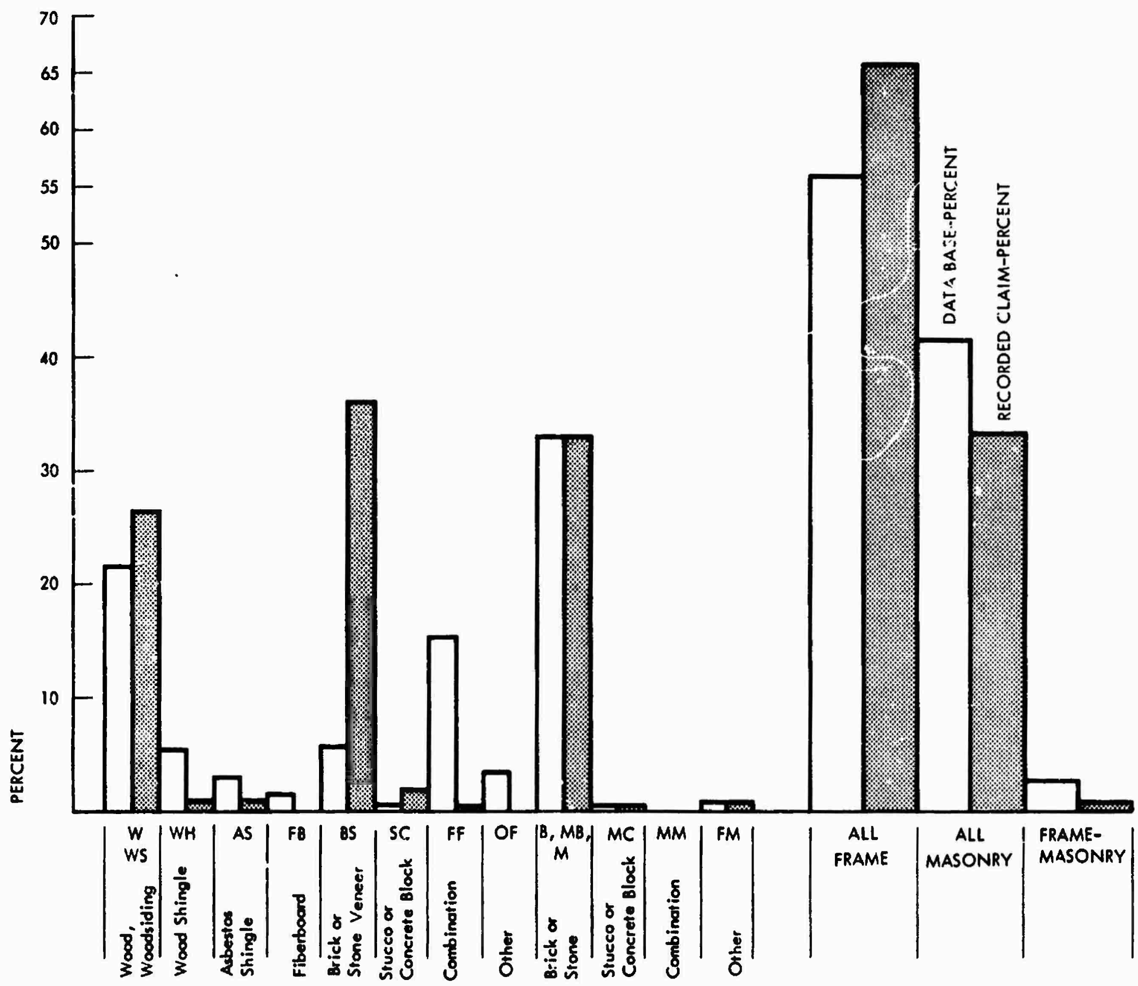
STRUCTURAL CHARACTERISTICS VERSUS AGE AND USE - OKLAHOMA BOOM AREA

Characteristics	Use: Single Family, 1959 or Earlier, Claims, Number	Claims %	FHA Base %	Single Family, 1960 or Later, Claims, Number	Claims %	FHA Base %	Multiple Family, 1959 or Earlier, Number	Multiple Family, 1960 or Later, Number	Commercial, 1959 or Earlier, Number	Commercial, 1960 or Later, Number
Frame										
Wood, wood siding (W,WS)	72	40.0%	22.5%	2	6.3%	1.7%	2		--	-
Wood shingle (WH)	6	3.3	0.9	--		--	-		--	-
Asbestos shingle (AS)	7	3.9	9.2	--		--	-		--	-
Fiberboard (FB)	--	--	0.4	--		0.6	-		--	-
Brick or stone veneer (BS)	78	43.6	59.7	29	90.5	94.2	2		4	1
Stucco or concrete block (SC)	3	1.7	0.6	1	3.2	0.1	-		3	-
Combination (FF)	1	0.6	4.6	--		3.2	-		--	-
Other (OF)	--	--	1.0	--		--			--	-
Masonry										
Brick or stone (B,MB,M)	7	3.9	0.5	--		0.2	1		14	2
Stucco or concrete block (MC)	2	1.2	0.4	--		--	-		6	1
Combination (MM)	2	1.2	--	--		--	-		2	-
Other (CC,OM)	--	--	0.1	--		--	-		1	3
Frame-Masonry										
Combination (FM)	1	0.6	0.1	--		--			1	-
		100 %	100 %		100 %	100 %				
Steel										
Light frame (SL)	--	--	--	--	--	--	-		--	1

Note: Source for FHA Base taken from "FHA Homes--1964."

Figure F-9

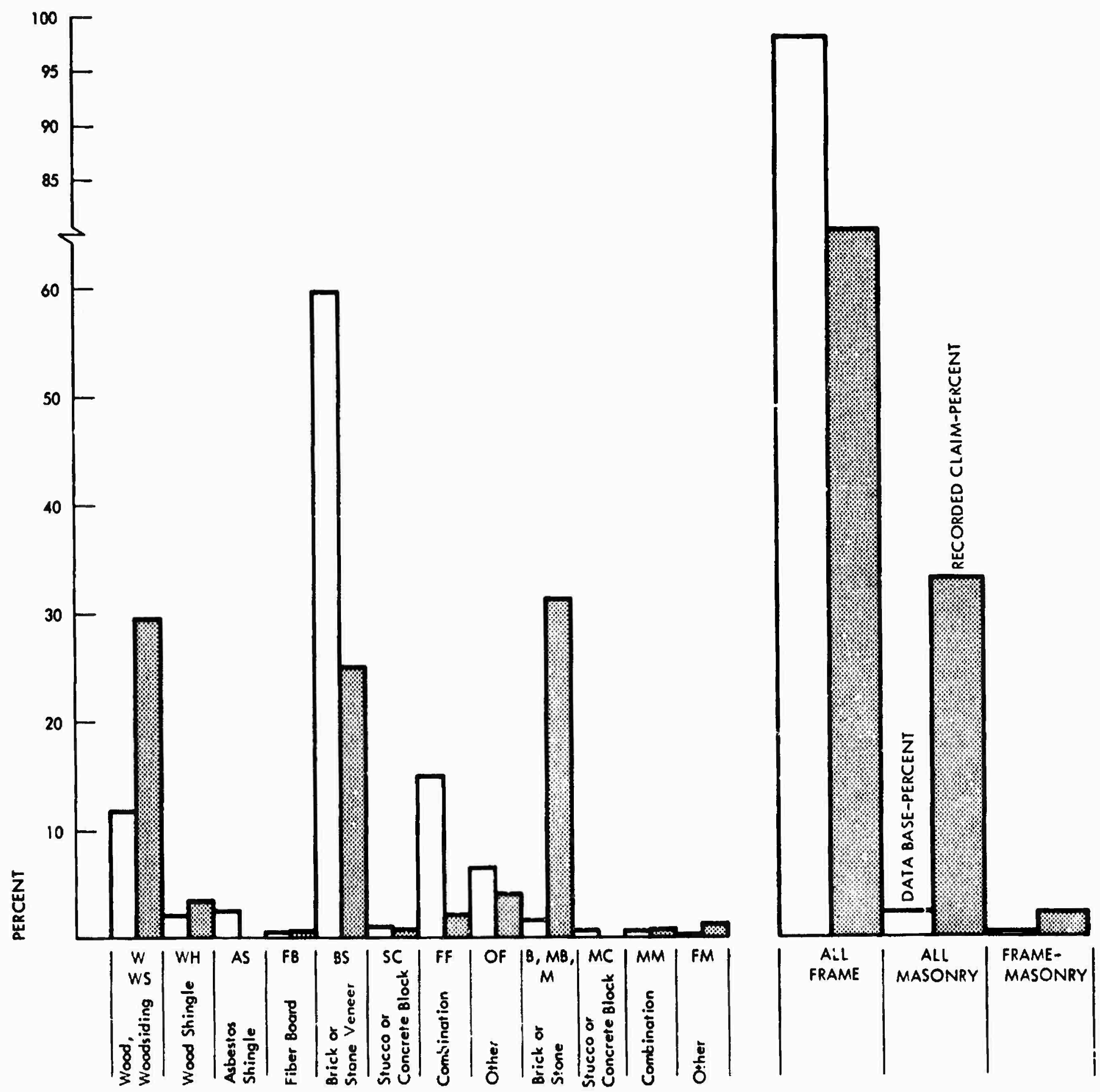
BUILDING CHARACTERISTICS - Chicago Boom Area



NOTE: Recorded structures older than 1960 are considered. Data base in percent of different characteristics found in "FHA Homes - 1964". Structures damaged are reduced to percent of total claims recorded for single family dwellings older than 1960.

Figure F-10

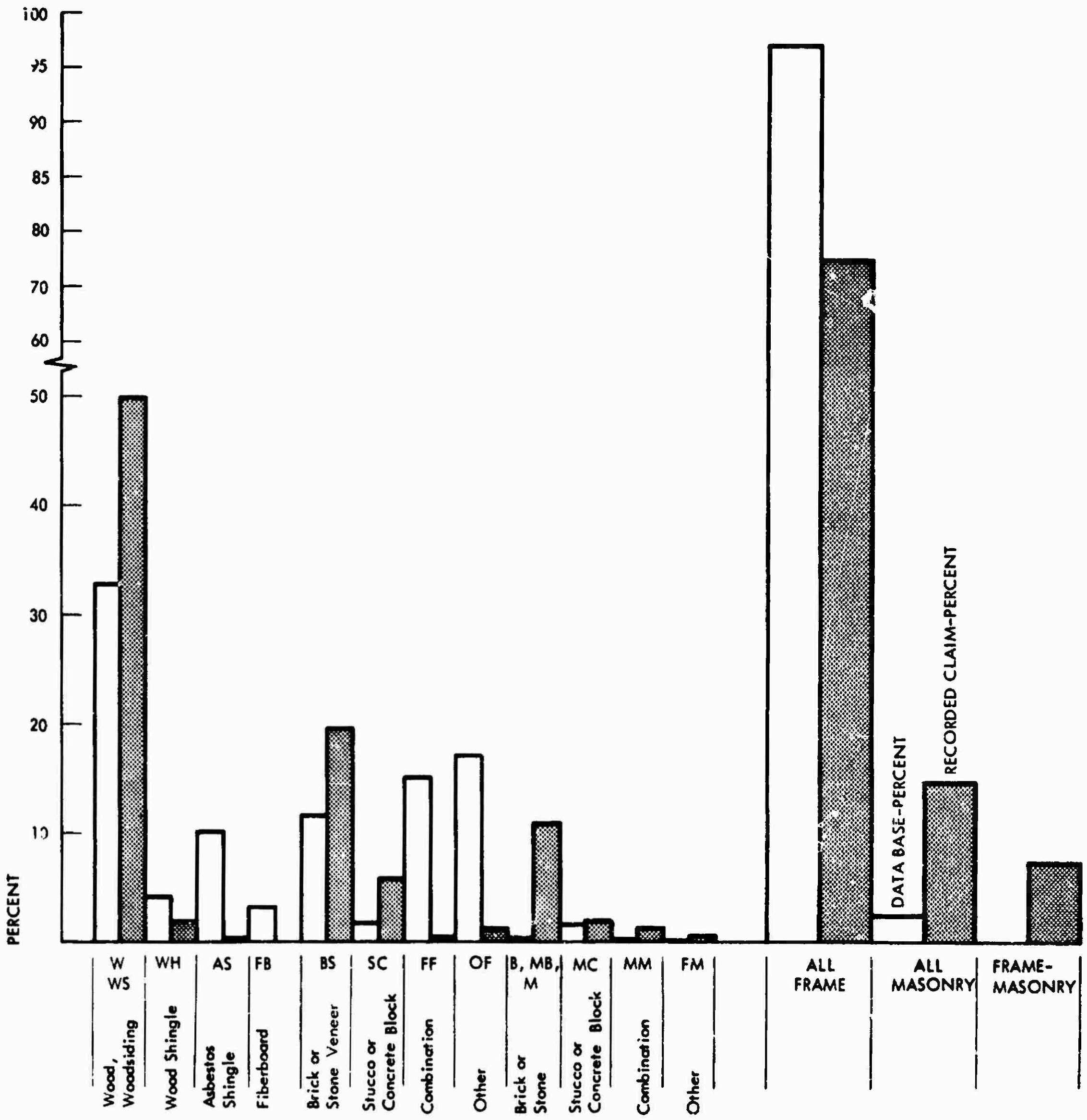
BUILDING CHARACTERISTICS - Pittsburgh Boom Area



NOTE: Recorded structures older than 1960 are considered. Data base in percent of different characteristics found in "FHA Homes - 1964". Structures damaged are reduced to percent of total claims recorded for single family dwellings older than 1960.

Figure F-11

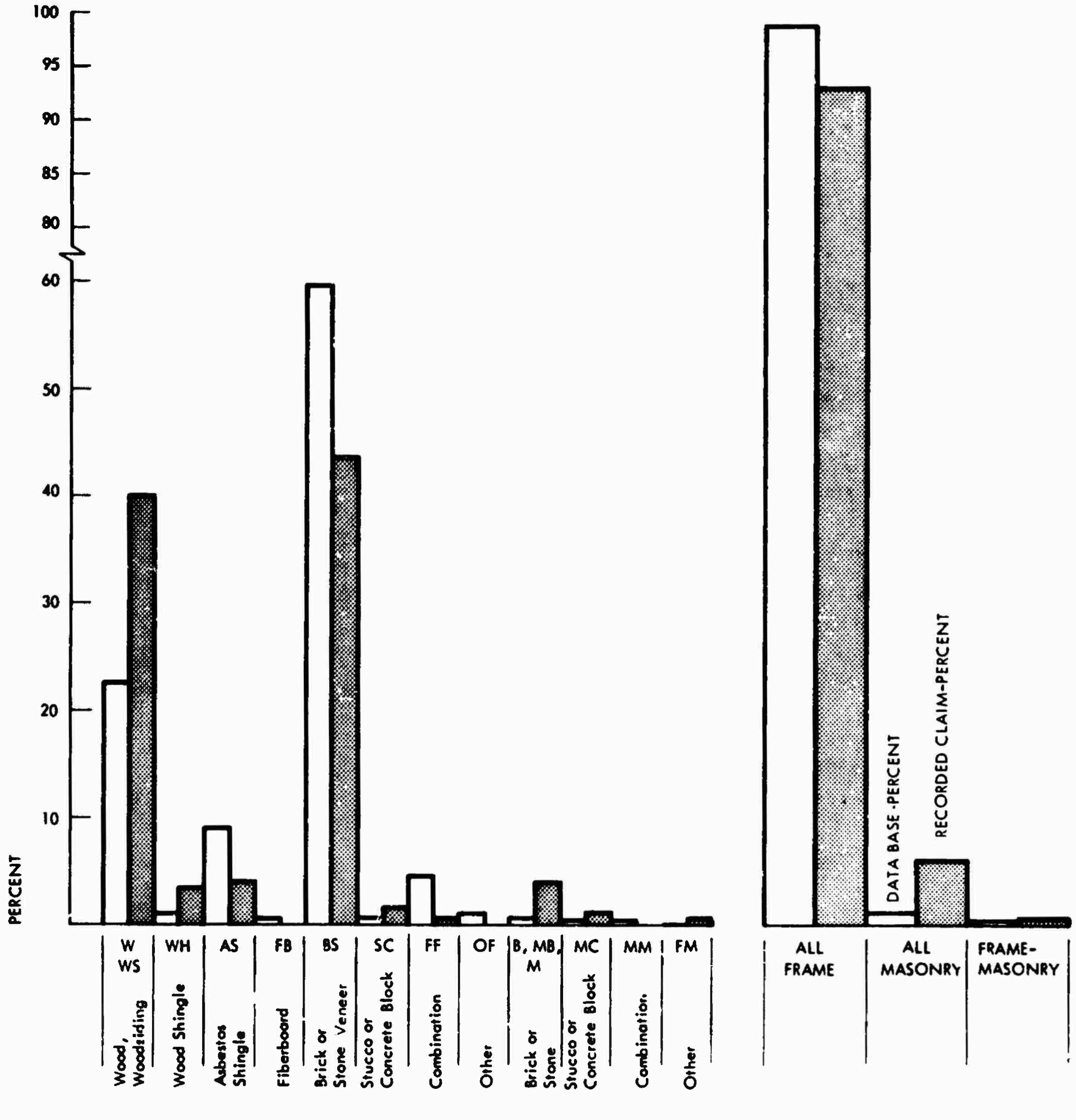
BUILDING CHARACTERISTICS - Milwaukee Boom Area



NOTE: Recorded structures older than 1960 are considered. Data base in percent of different characteristics found in "FHA Homes - 1964". Structures damaged are reduced to percent of total claims recorded for single family dwellings older than 1960.

Figure F-12

BUILDING CHARACTERISTICS - Oklahoma City Boom Area



NOTE: Recorded structures older than 1960 are considered. Data base in percent of different characteristics found in "FHA Homes - 1964". Structures damaged are reduced to percent of total claims recorded for single family dwellings older than 1960.

Table F-16

SUMMARY, FIGURES F-4, F-5, F-6, F-7

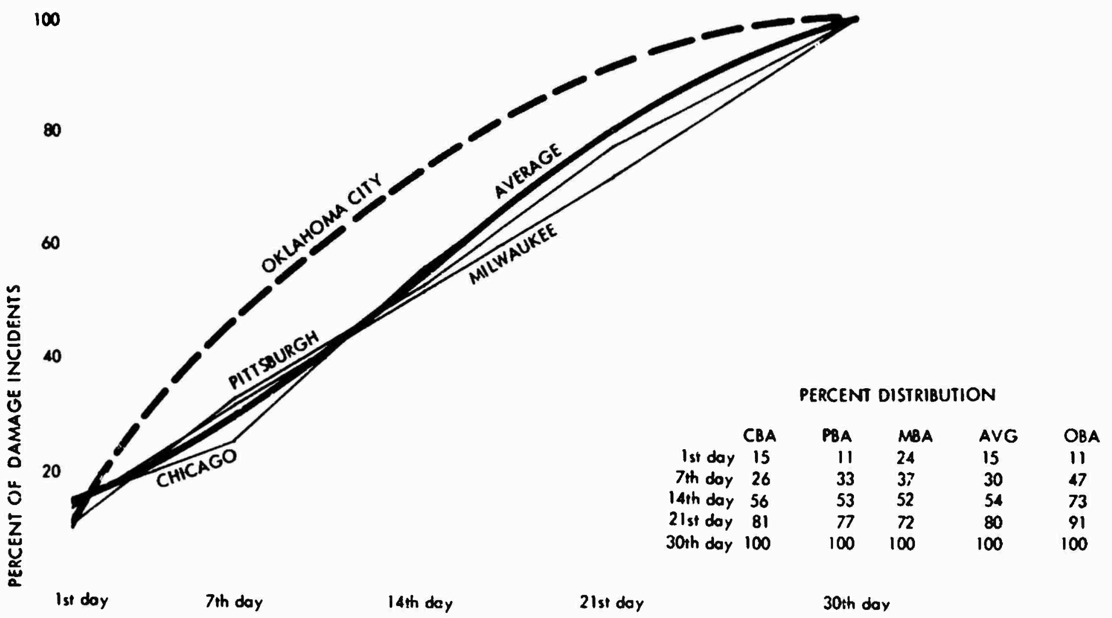
	CBA*	PBA*	MBA*	OBA*
Approximately 80% of damage complaints were registered during the period of B-58 sonic booms. (Figure F-4)	87%	78%	71%	—
Approximately 50% of the claims were filed after completion of the B-58 boom period. (Figure F-4)	49%	55%	49%	—

(Continued on page F-48)

* CBA—Chicago boom area
PBA—Pittsburgh boom area
MBA—Milwaukee boom area
OBA—Oklahoma City boom area

Figure F-13

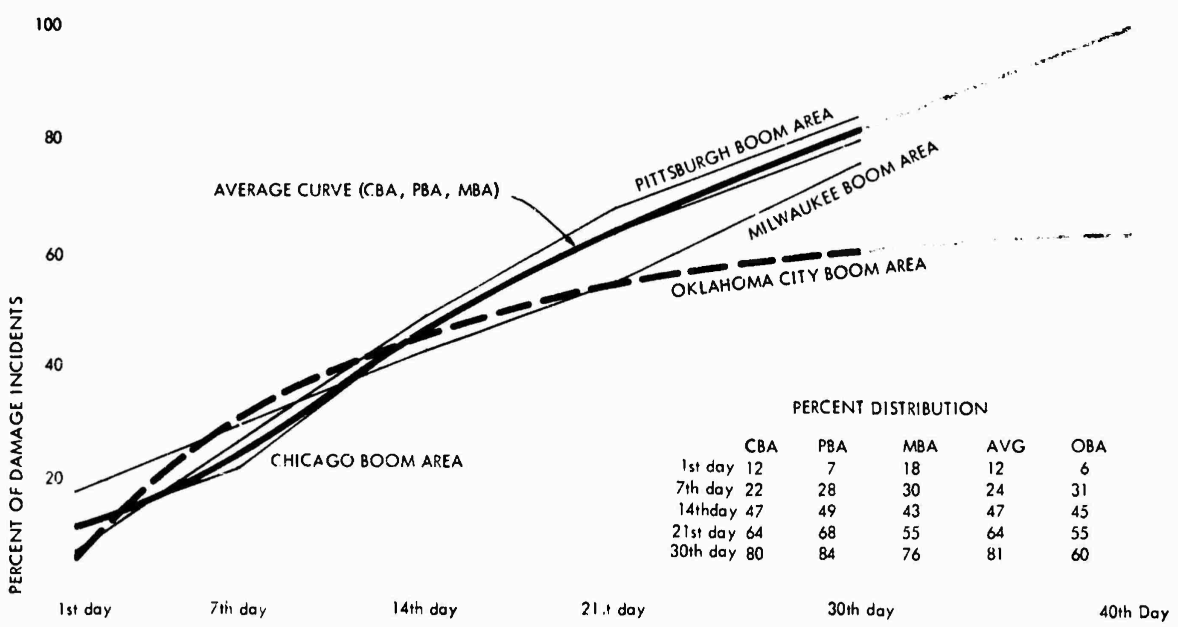
TOTAL DAMAGE INCIDENTS VERSUS BOOM ACTIVITY DAYS (Normalized to 30 Day Period)



PERCENT DISTRIBUTION

	CBA	PBA	MBA	AVG	OBA
1st day	15	11	24	15	11
7th day	26	33	37	30	47
14th day	56	53	52	54	73
21st day	81	77	72	80	91
30th day	100	100	100	100	100

TOTAL DAMAGE INCIDENTS VERSUS BOOM ACTIVITY DAYS



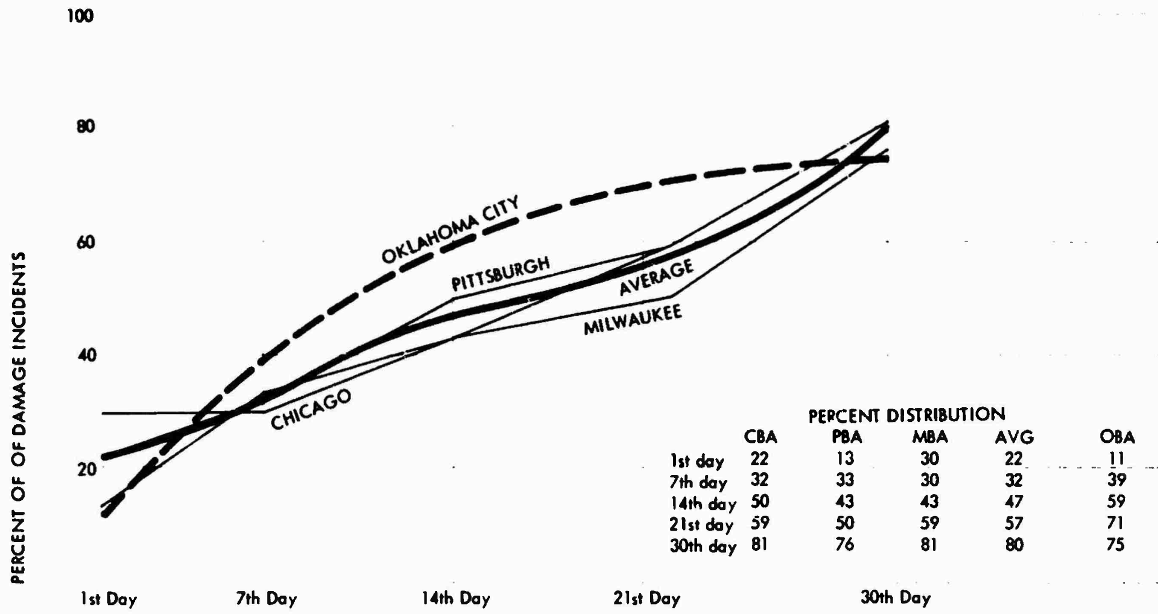
PERCENT DISTRIBUTION

	CBA	PBA	MBA	AVG	OBA
1st day	12	7	18	12	6
7th day	22	28	30	24	31
14thday	47	49	43	47	45
21st day	64	68	55	64	55
30th day	80	84	76	81	60

Approximately 45% of all damage incidents occurred within 14 days of boom activity.

Figure F-14

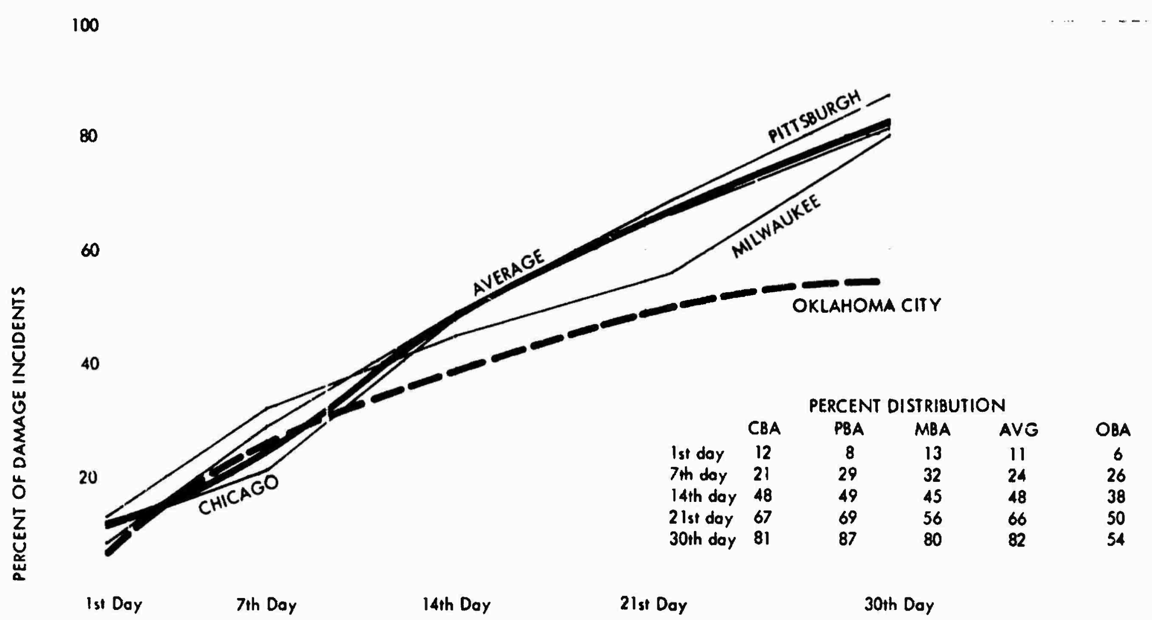
TOTAL DAMAGE INCIDENTS FOR PLASTER VERSUS BOOM ACTIVITY DAYS



PERCENT DISTRIBUTION

	CBA	PBA	MBA	AVG	OBA
1st day	22	13	30	22	11
7th day	32	33	30	32	39
14th day	50	43	43	47	59
21st day	59	50	59	57	71
30th day	81	76	81	80	75

TOTAL DAMAGE INCIDENTS FOR GLASS VERSUS BOOM ACTIVITY DAYS

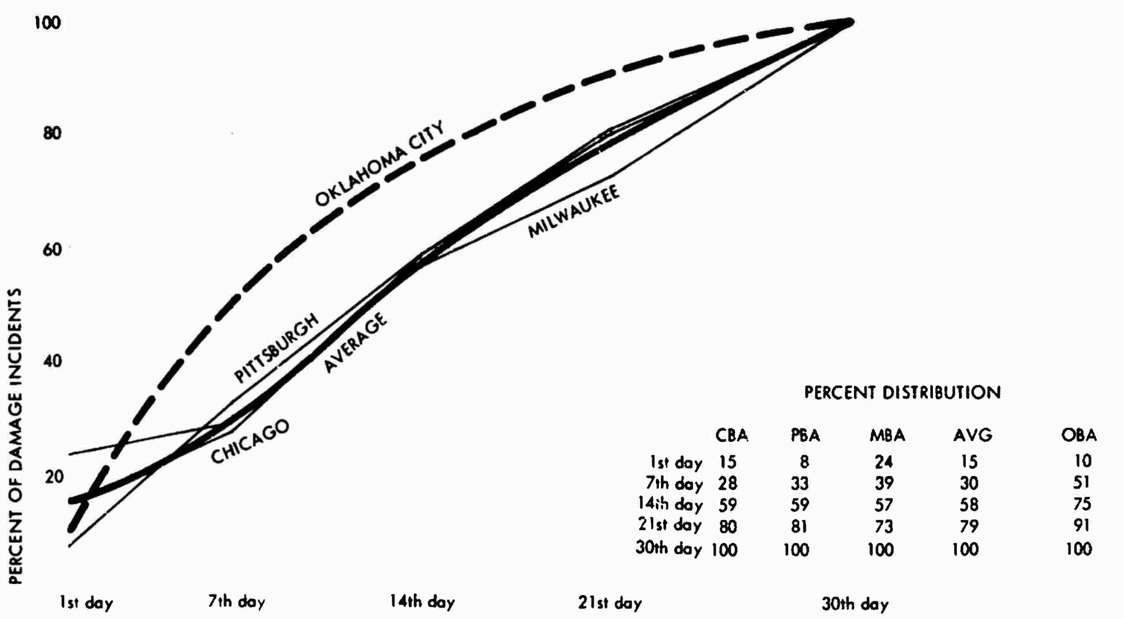


PERCENT DISTRIBUTION

	CBA	PBA	MBA	AVG	OBA
1st day	12	8	13	11	6
7th day	21	29	32	24	26
14th day	48	49	45	48	38
21st day	67	69	56	66	50
30th day	81	87	80	82	54

Figure F-15

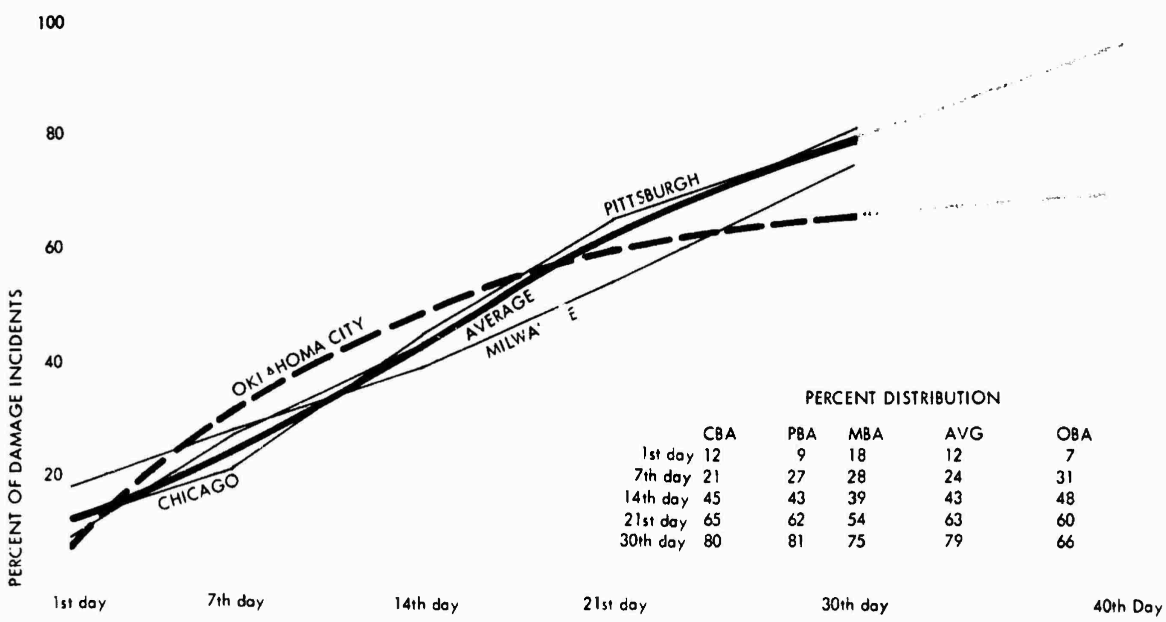
TOTAL DAMAGE INCIDENTS FOR SINGLE FAMILY DWELLING VERSUS BOOM ACTIVITY DAYS (Normalized to 30 Day Period)



PERCENT DISTRIBUTION

	CBA	PBA	MBA	AVG	OBA
1st day	15	8	24	15	10
7th day	28	33	39	30	51
14th day	59	59	57	58	75
21st day	80	81	73	79	91
30th day	100	100	100	100	100

TOTAL DAMAGE INCIDENTS FOR SINGLE FAMILY DWELLING VERSUS BOOM ACTIVITY DAYS



PERCENT DISTRIBUTION

	CBA	PBA	MBA	AVG	OBA
1st day	12	9	18	12	7
7th day	21	27	28	24	31
14th day	45	43	39	43	48
21st day	65	62	54	63	60
30th day	80	81	75	79	66

Approximately 60% of all damage to or in single family homes occurred within 21 days of boom activity.

Figure F-16

DAMAGE VERSUS DATE OF INCIDENT - Chicago Boom Area

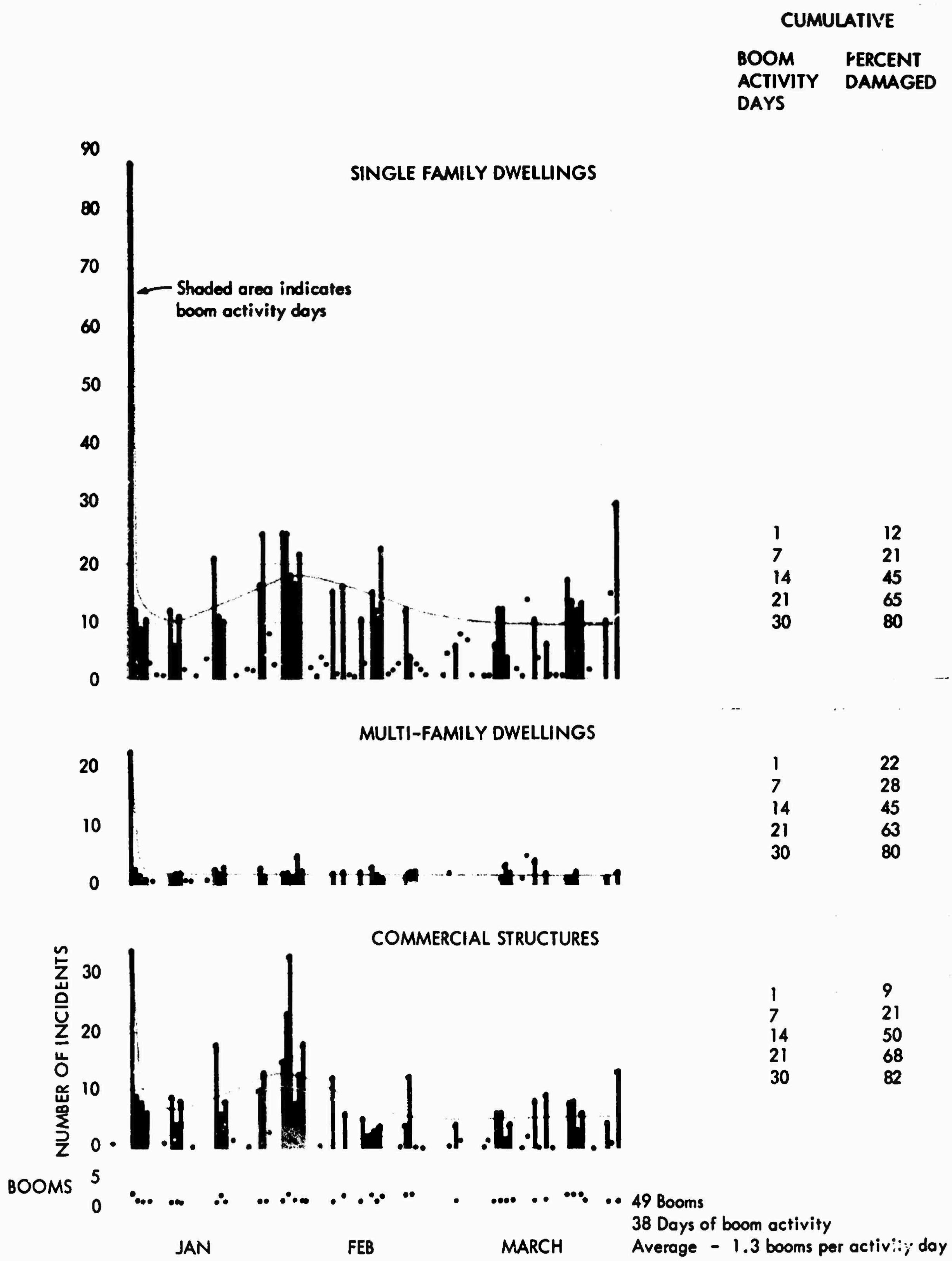


Figure F-16 (continued)

DAMAGE VERSUS DATE OF INCIDENT - Chicago Boom Area

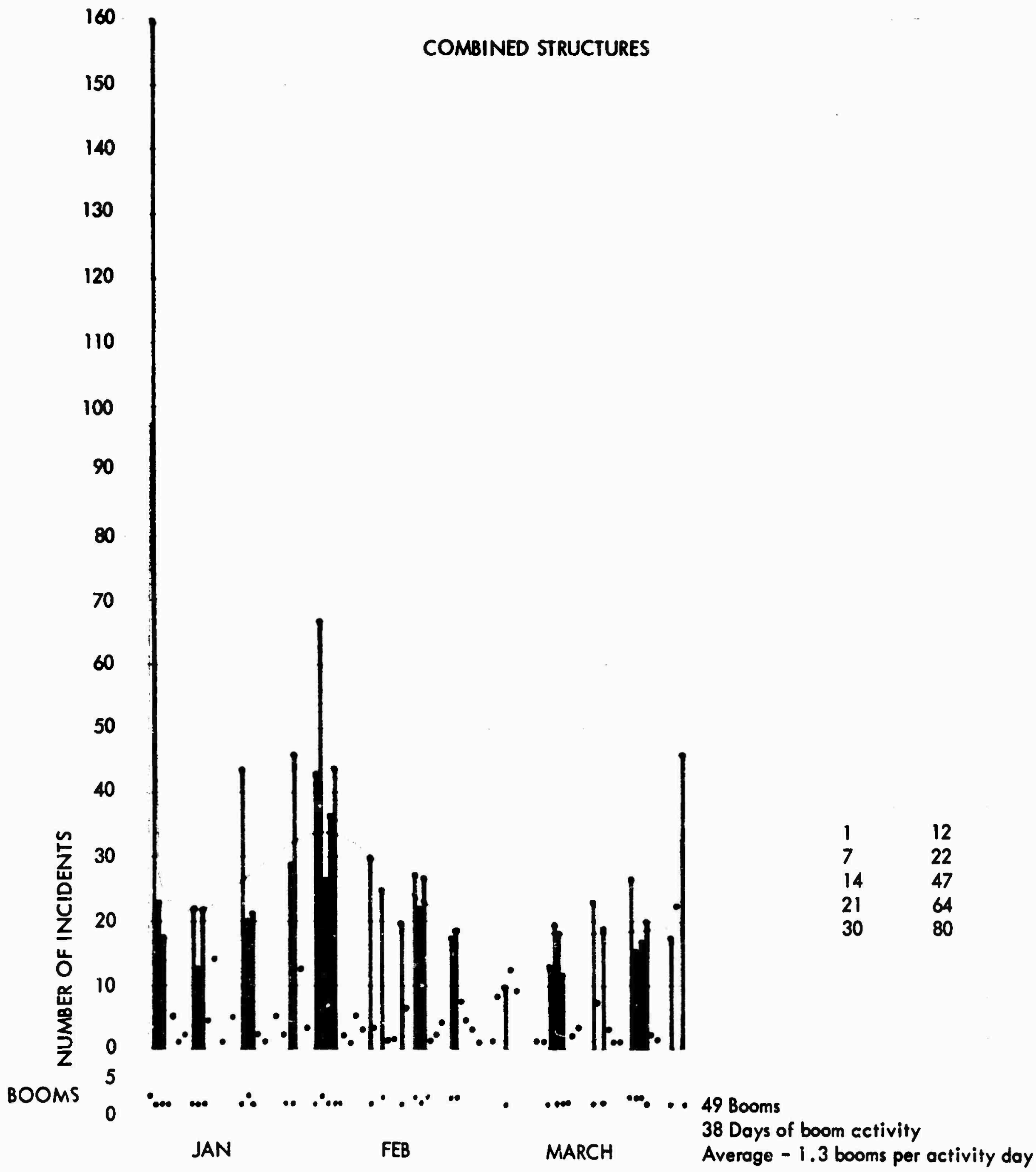


Figure F-16 (concluded)

DAMAGE VERSUS DATE OF INCIDENT - Chicago Boom Area

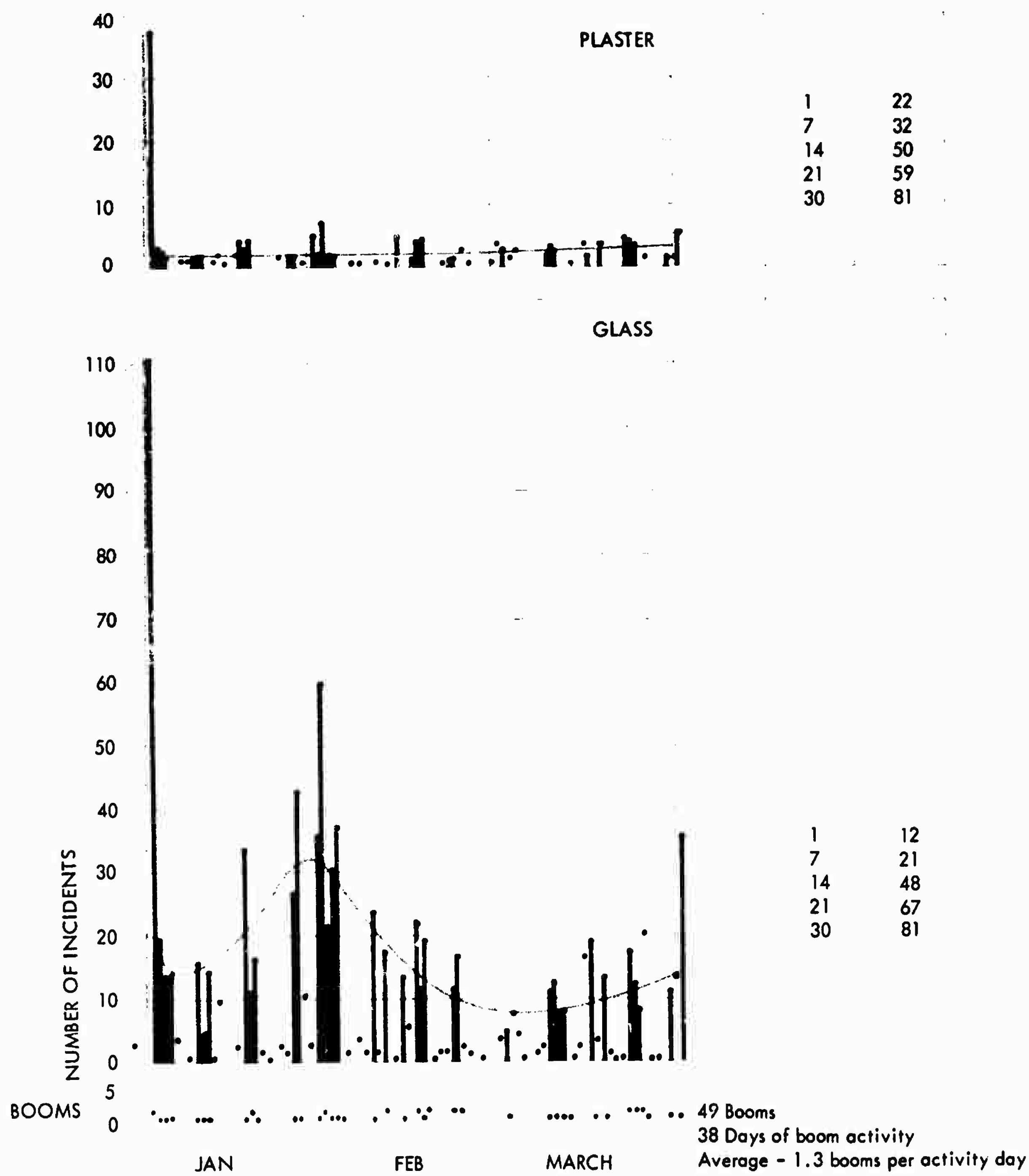
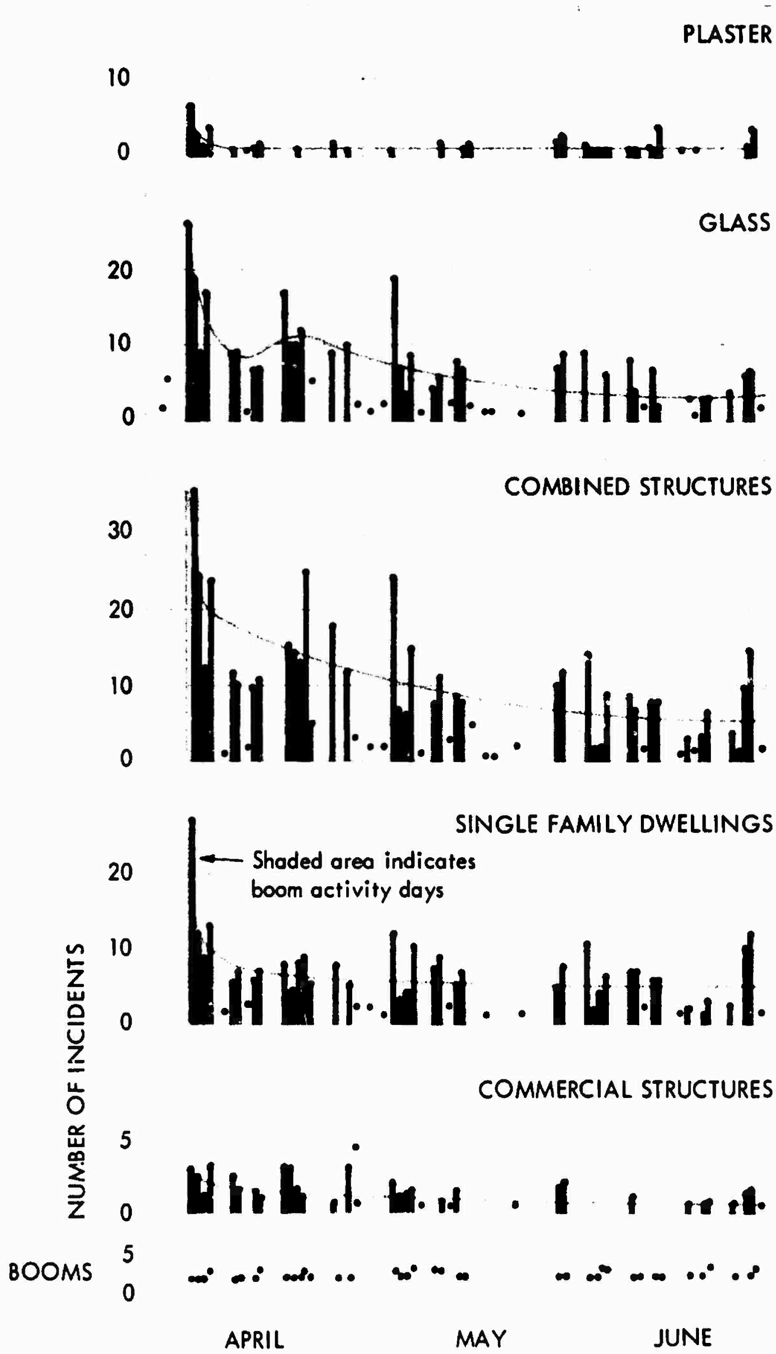


Figure F-17

DAMAGE VERSUS DATE OF INCIDENT - Pittsburgh Boom Area



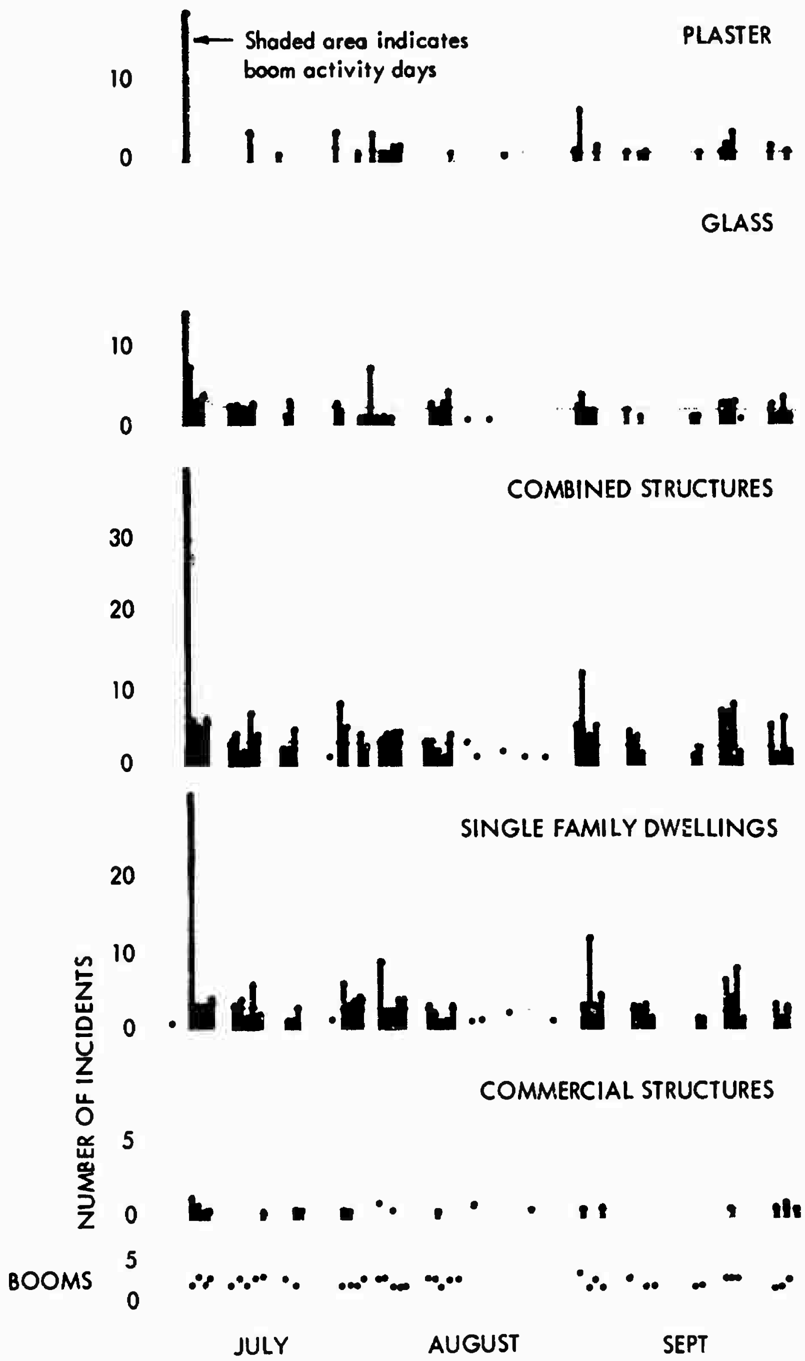
CUMULATIVE

	BOOM ACTIVITY DAYS	PERCENT DAMAGED
PLASTER	1	13
	7	33
	14	43
	21	50
	30	76
GLASS	1	8
	7	29
	14	49
	21	69
	30	87
COMBINED STRUCTURES	1	8
	7	28
	14	49
	21	68
	30	84
SINGLE FAMILY DWELLINGS	1	9
	7	27
	14	43
	21	62
	30	81
COMMERCIAL STRUCTURES	1	7
	7	33
	14	61
	30	92

50 Booms
39 Days of boom activity
Average - 1.3 booms per activity day

Figure F-18

DAMAGE VERSUS DATE OF INCIDENT - Milwaukee Boom Area



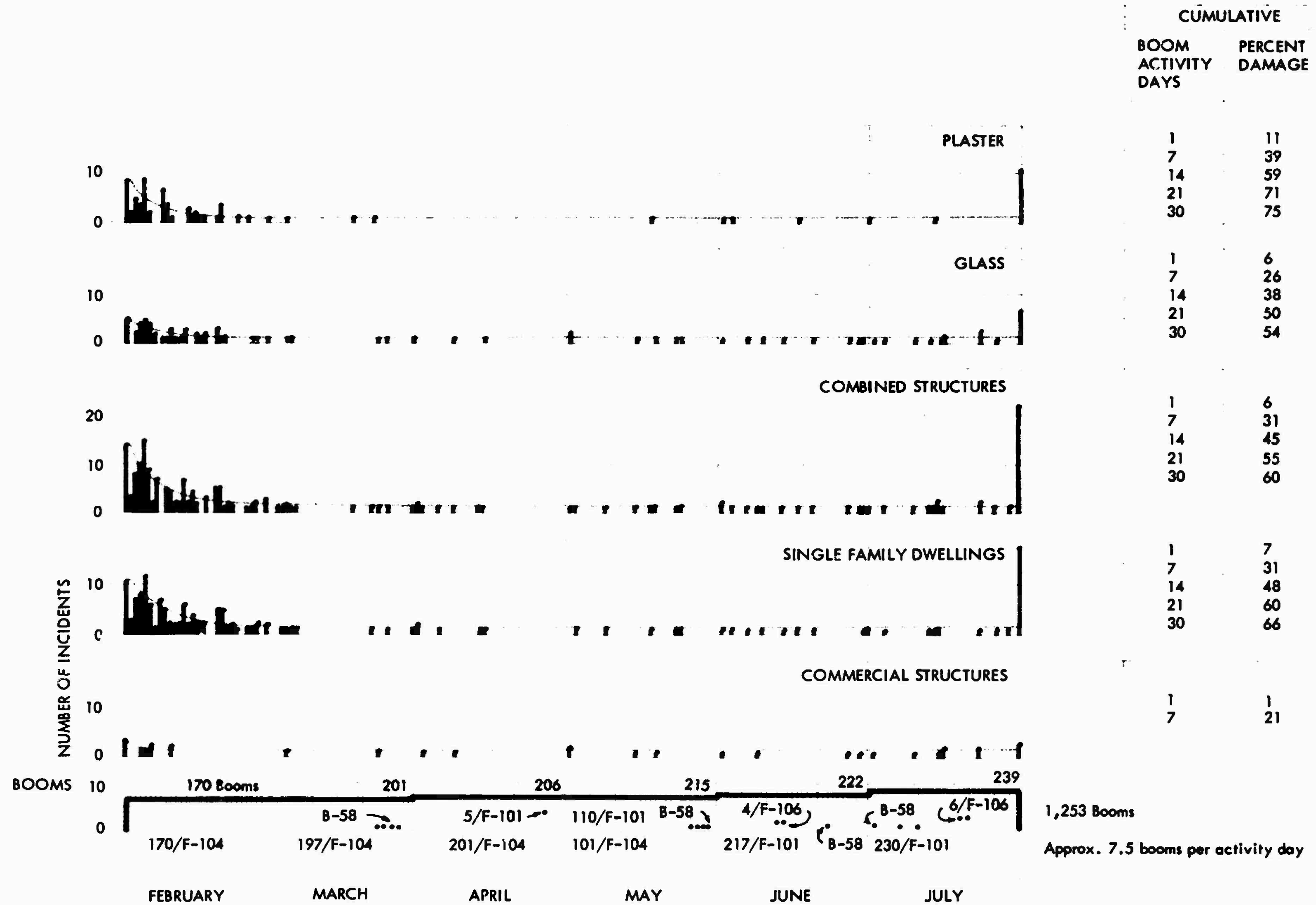
CUMULATIVE

	BOOM ACTIVITY DAYS	PERCENT DAMAGED
PLASTER	1	30
	7	30
	14	43
	21	59
	30	81
GLASS	1	13
	7	32
	14	45
	21	56
	30	80
COMBINED STRUCTURES	1	18
	7	30
	14	43
	21	55
	30	76
SINGLE FAMILY DWELLINGS	1	18
	7	28
	14	39
	21	54
	30	75
COMMERCIAL STRUCTURES	1	12

61 Booms
41 Days of boom activity
Average - 1.5 booms per activity day

Figure F-19

DAMAGE VERSUS DATE OF INCIDENT - Oklahoma City Boom Area



	CBA	PBA	MBA	OBA
In the Chicago, Pittsburgh, and Milwaukee boom areas: (Table F-3)				
Approximately 45% of all awards averaged $13	38%/$12	49%/$13	48%/$13	--
Approximately 35% of all awards averaged $51	33%/$51	31%/$51	38%/$50	--
Approximately 15% of all awards averaged $158	24%/$158	15%/$158	12%/155	--
Approximately 4% of all awards averaged $325	4%/$340	4%/$310	2%/310	--
Approximately 1% of all awards averaged $660	1%/$670	1%/$640	--	--
Greatest damage incidence was to single family homes;	60%	73%	85%	82%
Second, to commercial buildings;	29%	20%	10%	15%
Third, to multifamily structures;	10%	7%	5%	3%
Insignificant, industrial buildings. (Tables F-4, F-5, F-6, F-7)	<1%	--	--	--
In single family homes, the greatest damage type was glass, except for Oklahoma City where plaster damage was dominant (Tables F-4, F-5, F-6, F-7)				
Glass	67%	66%	40%	31%
Plaster	19%	15%	36%	52%
Other	14%	19%	24%	17%
In commercial buildings, glass damage predominated.	93%	90%	96%	82%

	CBA	PBA	MBA	OBA
In single and multifamily structures the greatest glass damage occurred to panes 2 feet to 4 feet in minimum dimension. (Tables F-4, F-5, F-6, F-7)				
Single family	55%	65%	63%	72%
Multifamily	70%	75%	50%	100%
In commercial structures, the greatest glass damage occurred to panes greater than 4 feet in minimum dimension. (Tables F-4, F-5, F-6, F-7)	87%	82%	73%	83%
On the average, two panes were damaged in each single family home glass incident. (Tables F-4, F-5, F-6, F-7)	2.0	2.3	2.0	1.7